A Dissertation on

"COMPARATIVE STUDY OF MICRODEBRIDER ASSISTED TURBINOPLASTY, SUBMUCOSAL DIATHERMY AND CONVENTIONAL SUBMUCOSAL RESECTION IN THE MANAGEMENT OF HYPERTROPHIED INFERIOR TURBINATE"

Submitted to the

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

In partial fulfilment of the requirements

For the award of the degree of

M.S.BRANCH IV
(OTORHINOLARYNGOLOGY)

GOVERNMENT KILPAUK MEDICAL
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DECLARATION

I, **Dr. J.ANGEL**, solemnly declare that the dissertation, titled "COMPARATIVE STUDY OF MICRODEBRIDER ASSISTED TURBINOPLASTY, SUBMUCOSAL DIATHERMY AND CONVENTIONAL SUBMUCOSAL RESECTION IN THE MANAGEMENT OF HYPERTROPHIED INFERIOR TURBINATE" is a bonafide work done by me during the period of January 2013 to September 2014 at Government Kilapuk Medical College and Hospital, Chennai under the expert supervision of **PROF. DR. K. RAVI, M.S., D.L.O., DNB.,** Professor and Head, Department Of Otorhinolaryngology , Government Kilpauk Medical College and hospital, Chennai.

This dissertation is submitted to The Tamil Nadu Dr. M.G.R. Medical University in partial fulfilment of the rules and regulations for the M.S. degree examinations in Otorhinolaryngology to be held in April 2015.

Place: Chennai-10

Date: **DR.J.ANGEL**

CERTIFICATE

This is to certify that the dissertation - "COMPARATIVE STUDY OF MICRODEBRIDER ASSISTED TURBINOPLASTY, SUBMUCOSAL DIATHERMY AND CONVENTIONAL SUBMUCOSAL RESECTION IN THE MANAGEMENT OF HYPERTROPHIED INFERIOR TURBINATE" presented by **DR.J.ANGEL**, is an original work done in the Department of Otorhinolaryngology, Government Kilpauk Medical College and Hospital, Chennai in partial fulfilment of regulations of the Tamilnadu Dr. M.G.R. Medical University for the award of degree of M.S. (Otorhinolaryngology) Branch IV, under my supervision during the academic period 2012-2015.

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ABBREVATIONS:

CNO	Chronic Nasal Obstruction
CPAP	Continuous Positive Airway Pressure
CT	Computed Tomography
DNE	Diagnostic Nasal Endoscopy
Ig	Immunoglobulin
IT	Inferior Turbinate
ITH	Inferior Turbinate Hypertrophy
MAIT	Microdebrider Assited Inferior Turbinoplasty
MT	Middle Turbinate
OPD	Out Patient Department
PNS	Paranasal Sinuses
SMD	Submucosal Diathermy
SMRIT	Submucosal Resection of Inferior Turbinate
VAS	Visual Analogue Scale
Yrs	Years

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ABSTRACT:

Recent times of the decade have seen great improvements in technology and its implication on mankind. As far as nose is concerned endoscopes and powered instruments keep doing wonders. The present study is one such kind where the powered instrument has been used to emphasize its efficacy. To talk about the common nasal symptom ENT consultants hear all the time is nasal obstruction. The present study is undertaken to compare three different techniques of inferior turbinate reduction surgery namely microdebrider assisted inferior turbinoplasty, conventional submucosal resection and submucosal diathermy which are done for the patients presenting with chronic nasal obstruction due to inferior turbinate hypertrophy refractory to medical treatment. The patients are selected for the study group based on four point symptom scale, inferior turbinate hypertrophy grading (DNE) and mucociliary transit time (Saccharin test). Three visits of postoperative follow up was done on 1st week, 4th week and 12th week after surgery. The patients in each study group are evaluated for relief of symptoms, improvement in nasal patency, mucociliary function and other outcomes of surgery and all the three techniques are compared for efficacy.

KEY WORDS: Inferior turbinate hypertrophy, Conventional Submucosal Resection, Microdebrider assisted Inferior turbinoplasty, Submucosal Diathermy

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Recent times of the decade have seen great improvements in technology and its implication on mankind. As far as nose is concerned endoscopes and powered instruments keep doing wonders. The present study is one such kind where the powered instrument has been used to emphasize its efficacy. To talk about the common nasal symptom ENT consultants hear all the time is nasal obstruction. The present study is undertaken to compare three different techniques of inferior turbinate reduction surgery namely microdebrider assisted inferior turbinoplasty, conventional submucosal resection and submucosal diathermy which are done for the patients presenting with chronic nasal obstruction due to inferior turbinate hypertrophy refractory to medical treatment. The patients are selected for the study group based on four point symptom scale, inferior turbinate hypertrophy grading (DNE) and mucociliary transit time (Saccharin test). Three visits of postoperative follow up was done on 1st week, 4th week and 12th week after surgery. The patients in each study group are evaluated for relief of symptoms, improvement in nasal patency, mucociliary function and other outcomes of surgery and all the three techniques are compared for efficacy.

KEY WORDS: Inferior turbinate hypertrophy, Conventional Submucosal Resection, Microdebrider assisted Inferior turbinoplasty, Submucosal Diathermy

INTRODUCTION:

The most common complaint that otolaryngologists have to deal with during their regular practice is chronic nasal obstruction. Nasal obstruction, despite of not being life threatening can very well interfere with the quality of life. Of which, Inferior turbinate hypertrophy is the commonly encountered cause for nasal obstruction. It is appreciated in conditions such as allergic rhinitis, chronic hypertrophic rhinitis, vasomotor rhinitis or compensatory hypertrophy due to septal deviations. The usual treatment advised for inferior turbinate hypertrophy due to various reasons are topical decongestants, anti-histamines and corticosteroids and are given to decrease the dimensions of the inferior turbinate with the particular aim of restoring the nasal function. Still, certain patients respond very poorly to medical therapy. Meanwhile a few are rather intractable to the above mentioned medical ailments and the patients pay repeated visits to the OPD with persistent symptoms. For such patients the different techniques of the inferior turbinate reduction surgeries which can be tried.

The results for sub mucosal resection of the turbinate show that it is an brilliant technique for alleviating nasal obstruction as well as rhinorrhoea and sneezing in patients presenting with perennial allergic rhinitis.

The powered instrument microdebrider very effectively removes not only the bone but also the soft tissue due to its rotation motor which can be attached to different kinds of drills and dissectors. In addition, this amazing tool enables us to obtain wonderful surgical visualization as the aspirator attached to it effectively removes any resected material and blood, making the field free of debris and increasing the working space. Furthermore, it plays an important role in reducing damage to the adjacent tissue due to the refrigerants which are perfused within the protection tube.

While assessing the different approaches of turbinate surgeries, the surgeon should in particular consider the important and necessary functions of the turbinates. In order to do that critical evaluation, it is mandatory to outline the ideal norms that a chosen surgical technique must fulfil so that the respective method is taken into account. The several important functions the inferior turbinate serves are as follows.

Resistor Function[5]:

The most important of all, the inferior turbinates contribute to the inspiratory resistance, which has a role in our normal breathing. When the nasal resistance is greater, so is the negative intrathoracic pressure that is desired for regular phase of inspiratory cycle. So, when the negative pressure increases, in turn, pulmonary ventilation is enhanced and hence the venous backflow to the lungs and the heart.

Diffusor Function:

The next in order is its diffusor function. It forms a part of the nasal valve area. The inferior turbinate serves to modify the inspiratory lamellar airstream into a turbulent air flow. The interaction between air and nasal mucosa is increased by the turbulence in the outer layers of air. Thereby the warming up, humidification and cleansing of the air[5] is much enhanced. This function of inferior turbinate is attributed to its large mucosal surface and extensive blood supply.

Defence Function:

Last but not the least, they are also essential in the protection of airway accounting for the nasal defence system where mucociliary transport, humoral and cellular defence are involved.

All of these nasal functions do require an enormous amount of completely normally functioning mucosa, submucosa, and turbinate parenchyma.

The existing turbinate reduction techniques focus on reducing the sub mucosal tissue invariably resulting in mucosal damage for want of wider operating field. Loss of mucosa gives rise to raw surface leading on to complications like nasal crusting, nasal bleeding, and very rarely atrophic rhinitis. Hence, the primary aim of inferior turbinate reduction surgeries is to reverse the nasal obstruction at the same time preserving as much as mucosa to restore the function of the turbinates.

AIM:

To compare the safety and efficacy of microdebrider assisted turbinoplasty, sub mucosal diathermy, conventional sub mucosal resection in patients with inferior turbinate hypertrophy.

OBJECTIVES:

By employing the above mentioned techniques to evaluate the following outcomes of inferior turbinate reduction surgeries :

1. Operative time
2. Blood loss
3. Subjective improvement of the patients' symptoms
4. Post-operative complications.
5. Objective improvement as noted in DNE
6. Mucociliary clearance time

STUDY DESIGN: Prospective study

PATIENT SELECTION:

Sixty patients presenting with nasal obstruction due to hypertrophied inferior turbinates intractable to medical treatment were included. Patients were randomly assigned to groups namely microdebrider assisted turbinoplasty (n=20) , submucosal diathermy (n=20) , conventional submucosal resection (n=20).

METHODOLOGY:

Patients (male and female in the age group of 16-50 years) who attended ENT Out-Patient Department with symptomatic Inferior turbinate hypertrophy refractory to medical treatment who fall under grade II and grade III were selected for this study. Sixty such patients were enrolled in the study once they satisfy the inclusion criteria. Informed written consent was obtained prior to the study.

Study design**:** Prospective Study

Institution**:** Department of ENT, Government Kilpauk Medical College Hospital and Government Royapettah Hospital.

Study period**:** December 2013 to September 2014.

Sample size**:** 60 patients

Sampling technique: Consecutive Sampling

INCLUSION CRITERIA:

1. 16-50 years of Age of both sexes.

2. Patients having nasal obstruction due to inferior turbinate hypertrophy refractory to medical treatment

3. Grade 2 and Grade 3 Inferior turbinate Hypertrophy

EXCLUSION CRITERIA:

1. Age below 16 years & above 50 years

2. Patients with nasal obstruction due to other conditions like nasal mass lesions

3. Patients who history of previous nasal surgeries.

4. Patients medically unfit for surgery

SURGICAL TECHNIQUES:

1. Microdebrider assisted turbinoplasty
2. Conventional Submucosal resection
3. Submucosal diathermy

FOLLOW UP:

Subjective assessment was made preoperatively with four-point symptom scale [3, 4] and inferior turbinate grading using DNE, CT PNS and mucociliary clearance using saccharin test.

Post-operative follow up was done using four point symptom scale, DNE and saccharin test at first week, 4 weeks and 12 weeks after surgery.

EQUIPMENTS USED:

1. 4mm – wide angled zero degree Hopkin endoscopes.
2. Video equipment consisting of three chip camera and accessories.
3. Microdebrider
4. Inferior turbinate blade- 2.9mm diameter
5. High definition LED monitor
6. Cautery
7. Routine FESS instruments

INFERIOR TURBINATE BLADE:

To overcome the disadvantages of traditional and techniques, the innovative Inferior Turbinate Blade in adult and pediatric sizes have been designed. Numerous studies show that powered inferior turbinoplasty offers significantly better long-term results. Inferior Turbinate Blade features a patented, elevated, rotating tip that allows removing tissue more precisely than traditional surgery tools, which helps protect the delicate mucosa. Unlike electrocautery, powered inferior turbinoplasty with the Inferior Turbinate Blade is a "cold" technique that helps to avoid unpredictable collateral thermal damage to surrounding tissue. The volume of reduction is immediately apparent since there is no delay for scar contracture. We have 2.9 mm as well as 4 mm diameter blades for use in inferior turbinate surgeries.

Fig 1: Inferior turbinate blade

CANDIDATE SELECTION FOR SURGERY:

Cases for study were selected based on routine examination of ear nose throat following which every patient underwent diagnostic nasal endoscopy. Patients with prominent mucosal hypertrophy were chosen after a decongestion test. This is because patients with hypertrophy of the bone alone and a thin mucosal covering don't make good candidates for microdebrider assisted turbinoplasty. Decongestion of the nasal cavities was done with xylometazoline packing. Those patients with significant shrinkage of the inferior turbinates following decongestion were selected for surgery.

PRE OPERATIVE ASSESSMENT:

1. **Four point symptom scale[3]:**

   The patients' symptoms are registered and four main symptoms associated with inferior turbinate hypertrophy are taken into account. The symptoms are nasal obstruction, sneezing, headache and hyposmia. These symptoms are graded according to four point symptom scale for each symptom. The grading of symptoms is mentioned in the later part of the discussion.

2. **Diagnostic Nasal Endoscopy:**

   To grade the inferior turbinate hypertrophy more accurately, diagnostic nasal endoscopy was performed preoperatively for every patient included in the study. This grading is necessary for objective assessment of surgical outcome.

3. **Saccharin Test:**

To assess the mucociliary transit time[6], saccharin test was done preoperatively as well as post operatively. The saccharin pellet was placed in the anterior end of the inferior turbinate. The start time was noted and the patients were instructed to notify when they were able to perceive the sweet taste in the throat and the end time is recorded. The normal mucociliary clearance time is between 10 to 20 minutes.

4. **CT PNS:**

To rule out other causes of nasal obstruction and as an anatomical guide for surgery, CT paranasal sinus was routinely done for all patients.

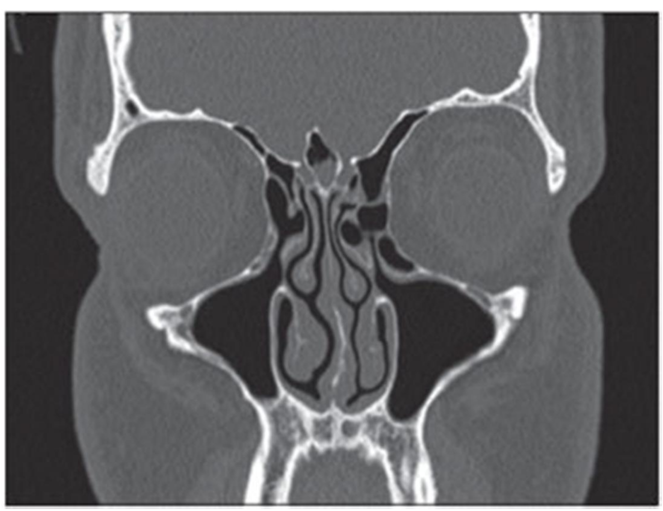


Fig 2: CT PNS showing bilateral inferior turbinate hypertrophy

PRE OPERATIVE PREPARATION:

- Xylocaine test dose was given to all patients selected for the study, using 0.1ml of 2% xylocaine which was injected into the left forearm intra-dermally, with the patient in the supine position and overlooked for any allergic response.
- The patients were kept on nil per-oral after 10 pm the night before surgery.
- Informed and written consents were obtained prior to surgery from the patients and attendants.
- The patients were put on a course of antibiotics pre-operatively.

ANAESTHESIA:

General Anaesthesia with oro-tracheal intubation was preferred for patients whose co-operation under Local Anaesthesia was doubtful. However, irrespective of the technique of anaesthesia, infiltration using the formulation of 2% xylocaine with adrenaline (1 in 80,000) was injected into the inferior turbinate.

SURGICAL PROCEDURE:

1.MICRODEBRIDER ASSISTED INFERIOR TURBINOPLASTY:

Initially, a sub mucosal plane was created by channeling with the help of a sharp instrument like septal elevator. The dissection was carried out from anterior end to posterior end. Then a plane is created in a vertical axis too. Following this step where a sub mucosal pocket is made, the inferior turbinate microdebrider blade is inserted and made to rotate constantly at 3,000 rpm in a circular manner. The other port of the blade which is connected to the suction, irrigates continuously and the debrided turbinate tissue is removed through the suction port as well. The procedure is performed meticulously keeping in mind not to sacrifice the mucosal flap while the debrider is in action. To remove more bulk in the posterior part of the turbinate, further advancement of the microdebrider blade is done and same procedure repeated. Anterior nasal packing was done for one day.

MICRODEBRIDER ASSISTED TURBINOPLASTY

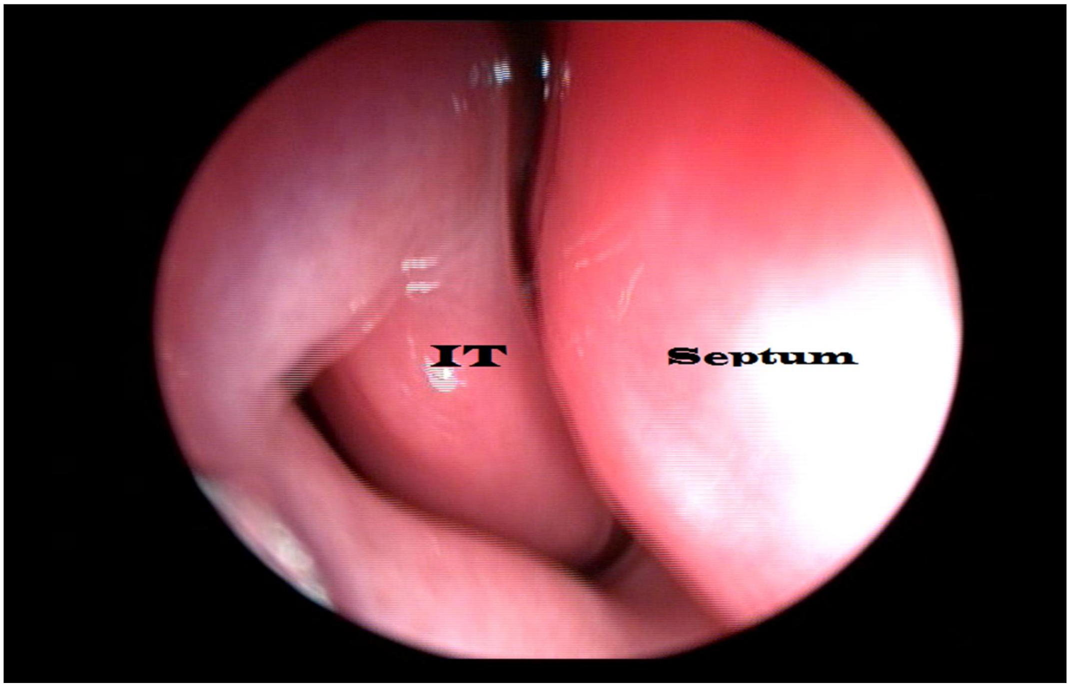


Fig 3: PreOperative DNE

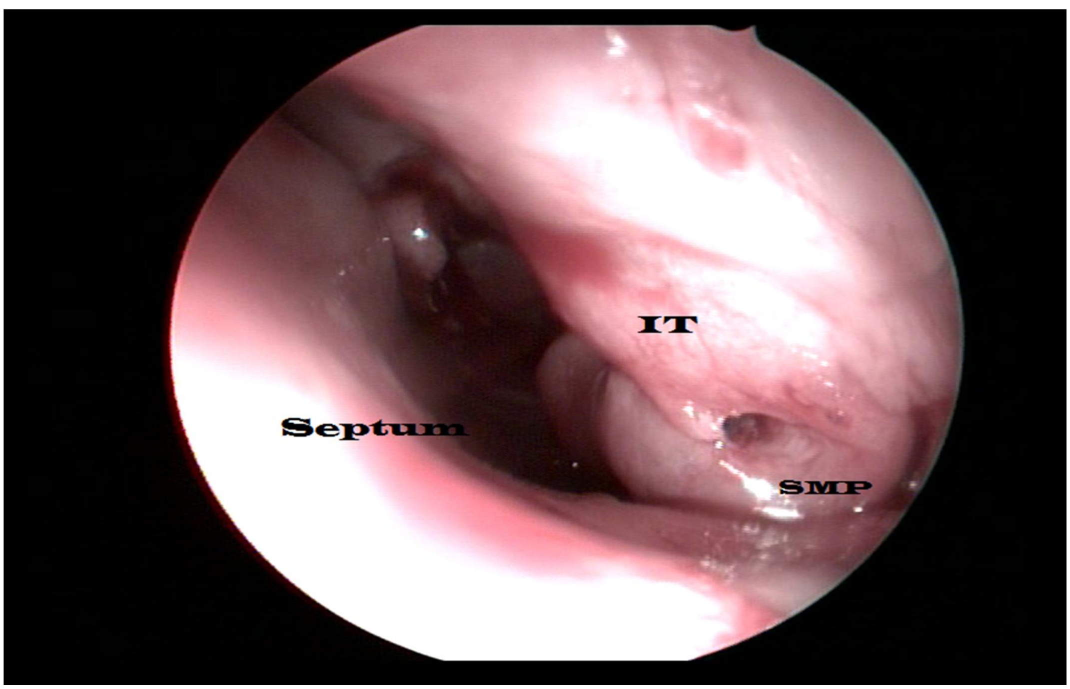


Fig 4: Creating Submucosal pocket (SMP)

MICRODEBRIDER ASSISTED TURBINOPLASTY

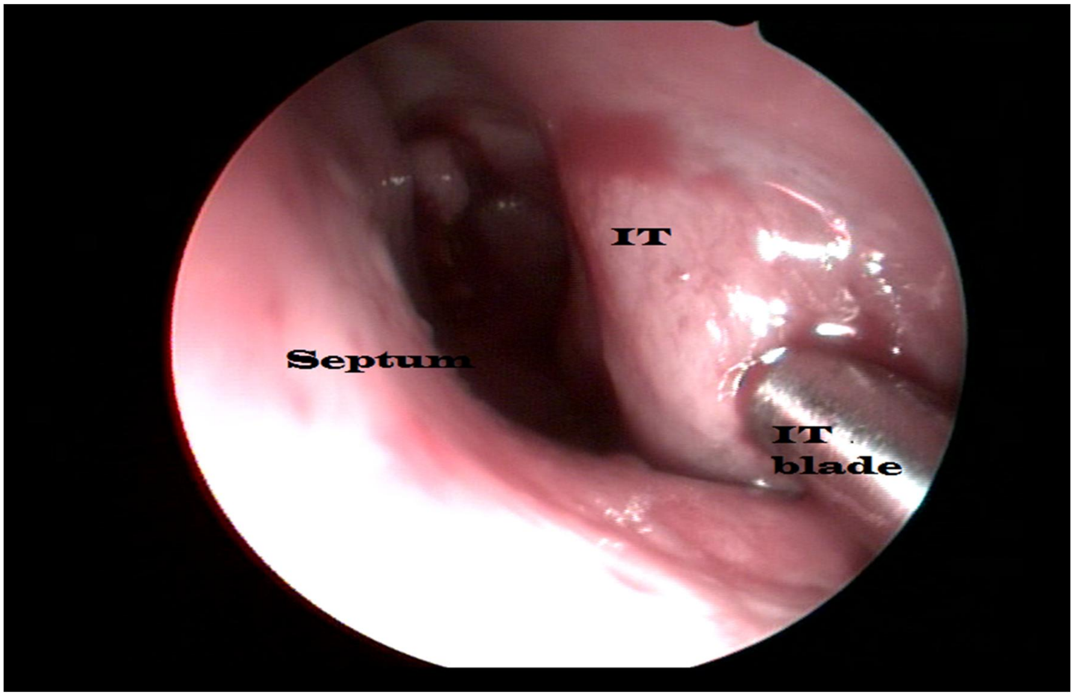


Fig 5: Introducing microdebrider blade into inferior turbinate

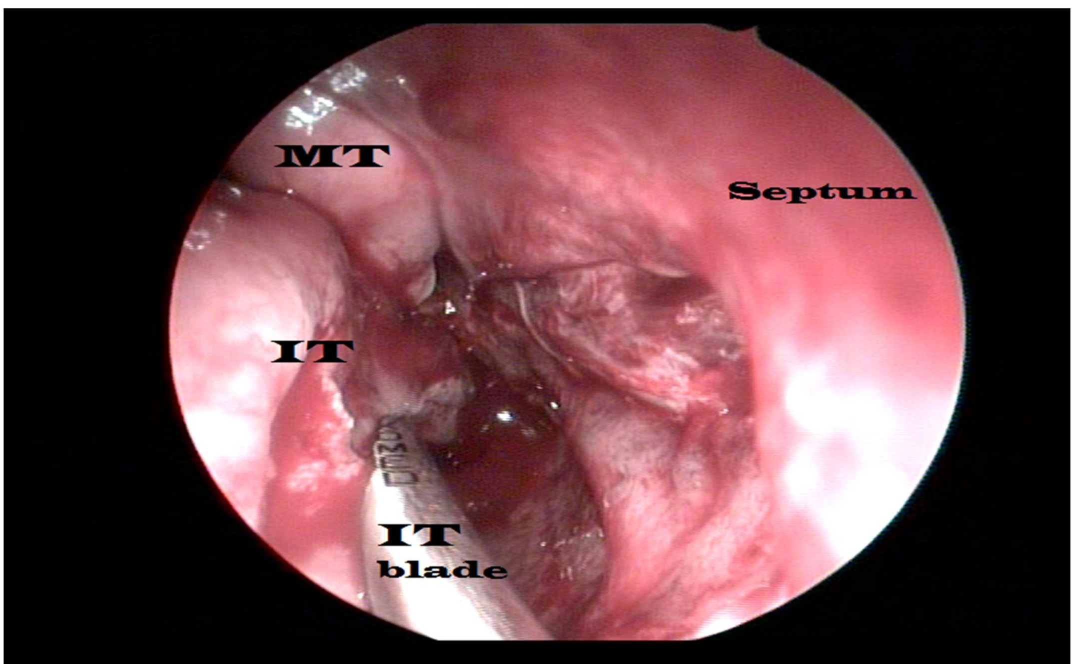


Fig 6: Resection of Inferior turbinate

MICRODEBRIDER ASSISTED TURBINOPLASTY

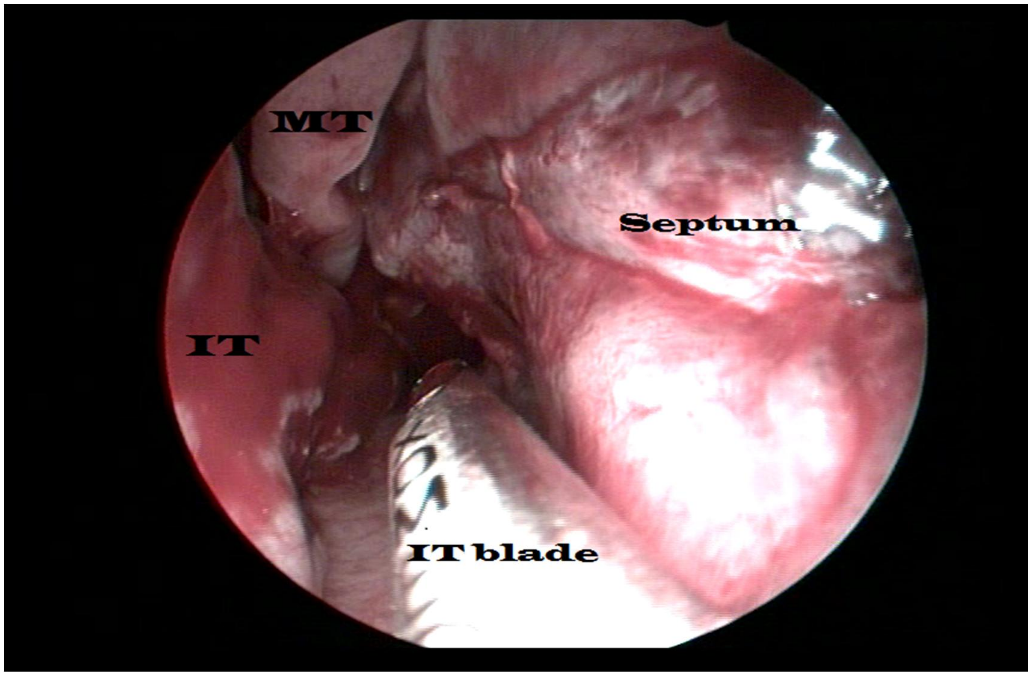


Fig 7: Immediate postop

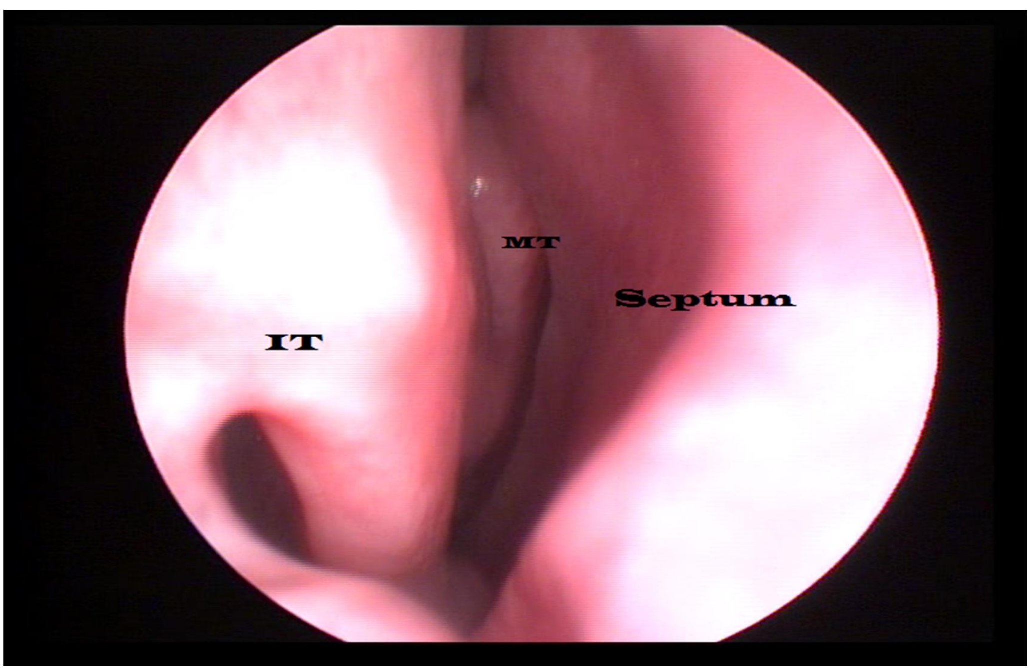


Fig 8: Post op at 4 weeks

2.SUBMUCOSAL RESECTION OF THE INFERIOR TURBINATE:

After infiltrating the inferior turbinate, an incision was made along the medial surface of the inferior turbinate from the anterior end to the posterior end. Dissection was carried out in the submucosal plane, elevating the mucosal flaps superiorly and inferiorly. A plane was created in the lateral surface also. The part of bulky turbinate bone was then removed using turbinectomy scissors. After removal of the bony turbinate, the superior and inferior flaps were repositioned. No suturing was necessary.

SUBMUCOSAL RESECTION OF THE IN FERIOR TURBINATE:

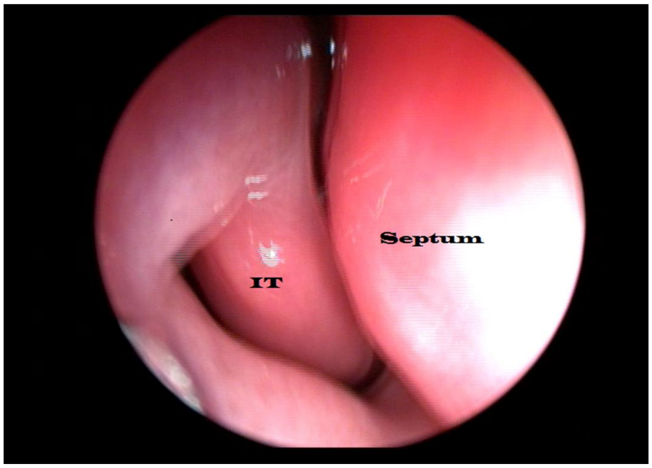


Figure 9: Preop DNE

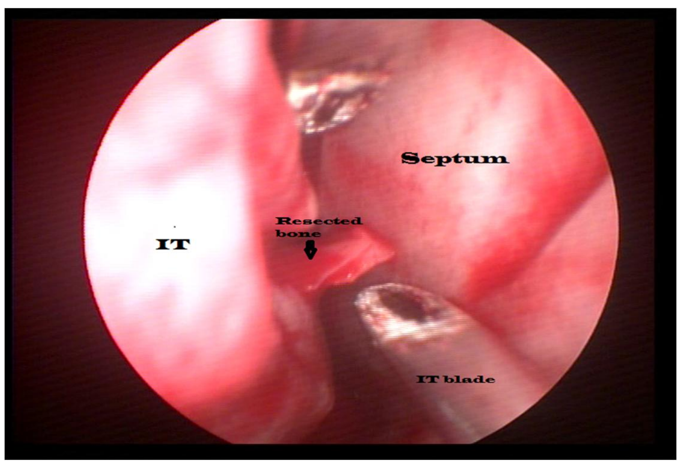


Fig 10: Resection of the turbinate

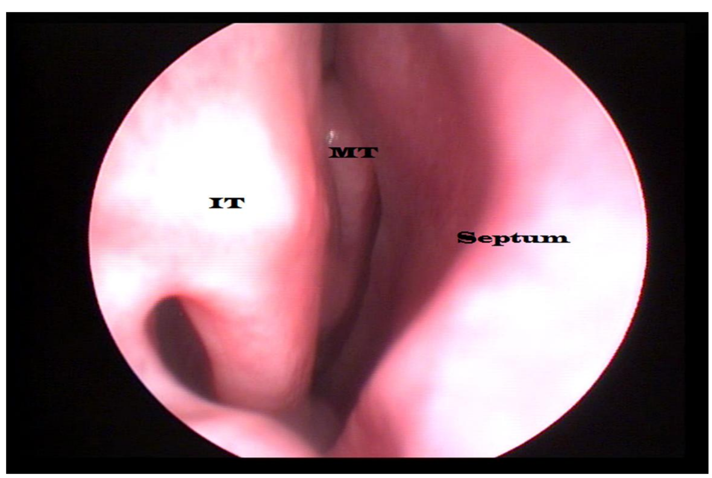


Fig 11: Postop 4th week

3.SUBMUCOSAL DIATHERMY:

The inferior turbinate is infiltrated. A long spinal or venflon needle is introduced inside the inferior turbinate. Cauterisation was done using monopolar cautery. The needle is further advanced in various positions and same procedure is performed. Care is taken not to cause thermal injury to vestibule skin.

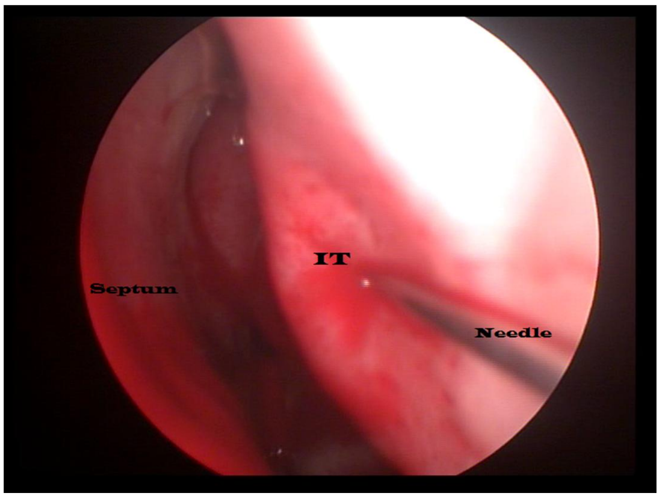


Fig !2: Infiltration of inferior turbinate

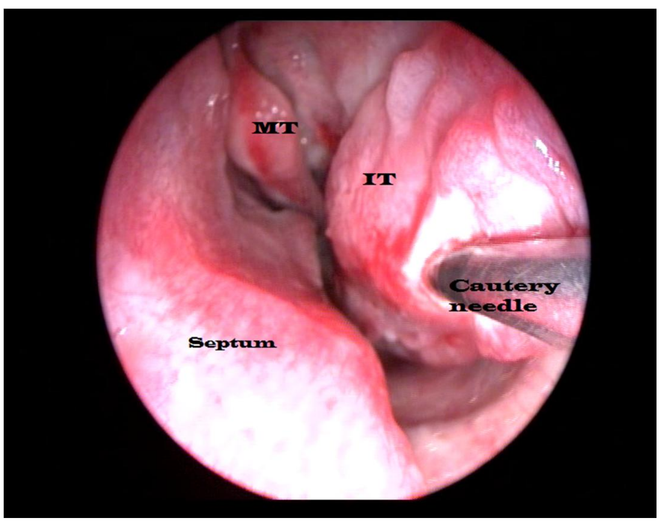


Fig 13: Introducing Cautery needle

SUBMUCOSAL DIATHERMY OF INFERIOR TURBINATE:

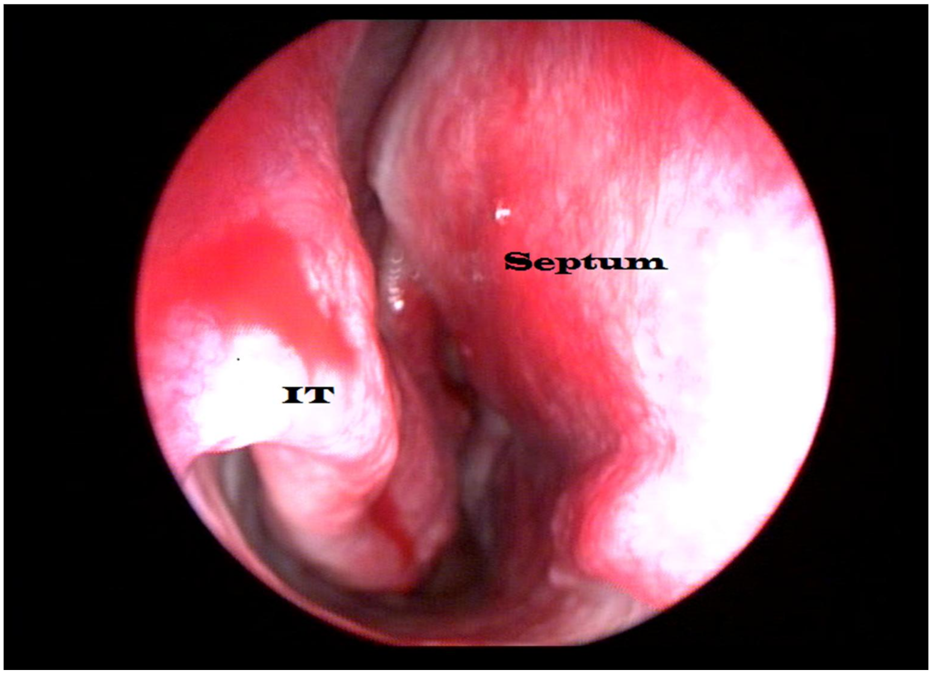


Fig 14 : Immediate postop

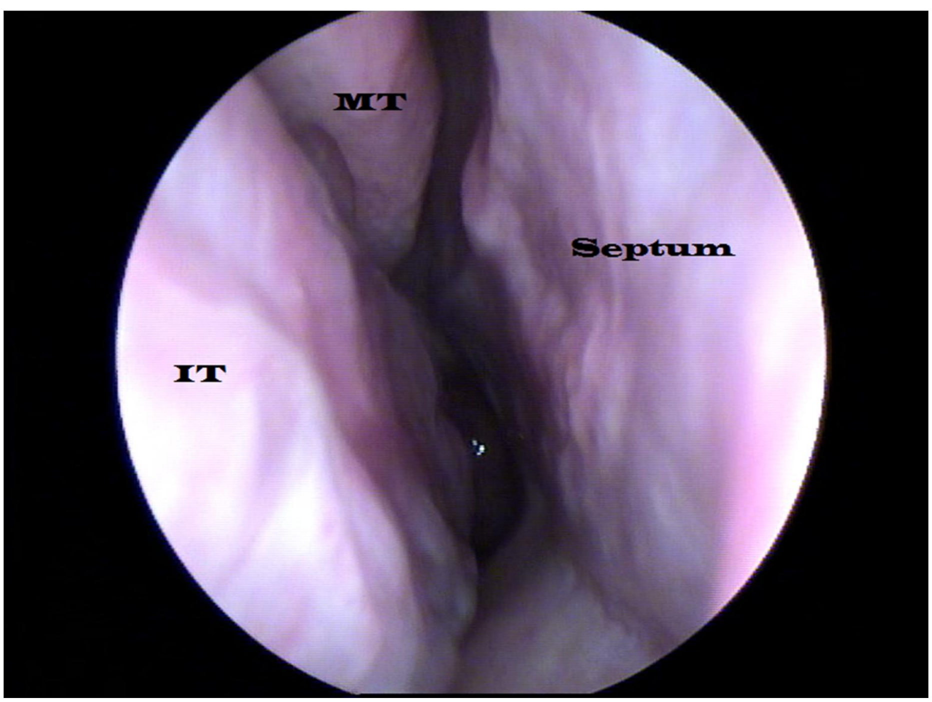


Fig 15 : Post op visit at 12 weeks

POSTOPERATIVE CARE:

The nasal pack was removed the next day after surgery. Oral antibiotics are continued for one week. Douching with nasal saline spray was used till the nasal mucosa healed. The post-operative follow up which included four point symptom scoring, diagnostic nasal endoscopy and saccharin tests was done 1 week, 4 weeks and 12 weeks after surgery. Post-operative VAS was analysed and values recorded. The degree of scarring, crusting and synechiae were documented at each visit.

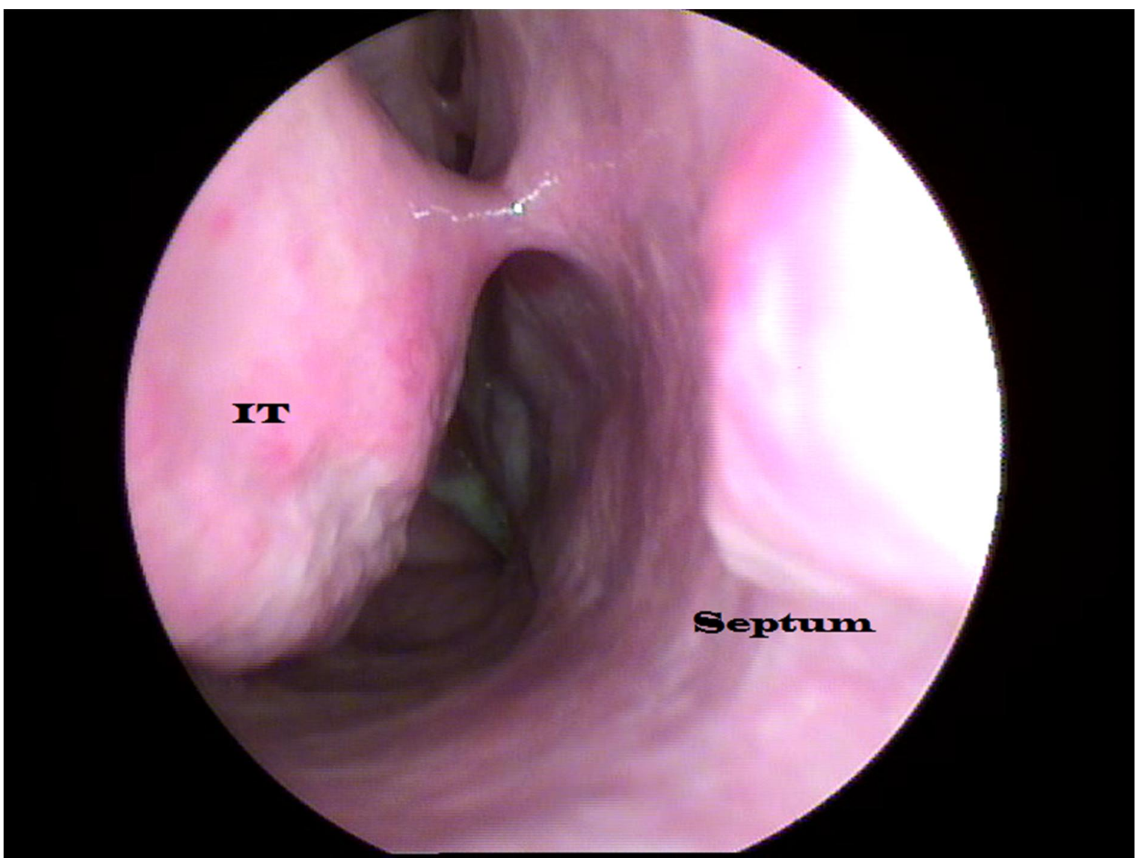


Fig 16: Synechiae in a patient from SMRIT group

THE TURBINATES[1]:

The lateral wall of the nose is marked by three turbinates and occasionally a fourth turbinate may exist. The turbinates are curved towards the lateral wall usually and has a shell-like appearance. The lining of the mucosa of turbinates is normally ciliated columnar epithelium. Lateral and behind each turbinate is situated a narrow passage called meatus. The inferior turbinate plays a major role in respiration indirectly where it aids in creating high nasal resistance therefore enhancing the negative intrathoracic pressure which is mandatory for the process of inspiration during normal breathing. It is necessary to divide the nasal passage into different parts, as each one of them has a great impact on the airflow during inspiration- vestibulum nasi, the isthumus nasi, the turbinates and the choana. The narrowest part of the nasal cavity being the isthumus contributes to the maximum nasal resistance to airflow. This ensures a laminar flow along the entire length of the segment. This is known as the nasal valve. The extent of nasal valve is from the inner ostium to a fewer distance of pyriform aperture. When the inferior turbinate is congested, it has a greater impact on the nasal valve segment.

The cross-sectional area of the nasal passage increases which leads to a diffuser phenomenon and thereby causing turbulence in the airflow which eventually cause a decrease in the velocity of the airflow. The highest contact of the air with the nasal mucosa is facilitated by the large surface area and unique architecture of the inferior turbinate.

EMBRYOLOGY [2]:

The initial turbinate development is attributed to the ridges situated in the lateral wall of the nose. They are named as the ethmoturbinals and the maxilloturbinal. It is during the eighth week of development around five or six ridges start to appear. They undergo consecutive regression which is followed by fusion. Out of these initial five ridges, say only three to four ridges persist at the end of development. Maxilloturbinal is the inferior most ridge. The ethmoturbinals turn into the middle turbinate, superior turbinate and the supreme turbinates. The lateral nasal wall holds only one ossification centre for the inferior concha. The primitive nasal capsule encircles the nasal cavity and is in line with the cartilaginous part of the septum. The preturbinates or soft tissue elevations[8] are oriented such that they are comparable in size and position with that of the adult concha. The cartilaginous capsule splits into two flanges that penetrate the lateral wall elevations of inferior and middle turbinates. The lateral nasal wall completely develops by 24 weeks of gestation. Meanwhile , the inferior turbinate has emerged from the two origins, the lateral cartilaginous capsule and the maxilla. Based on the initial mucosal thickening, turbinate development appears to be a primary process , and meatal ingrowth follows secondarily.

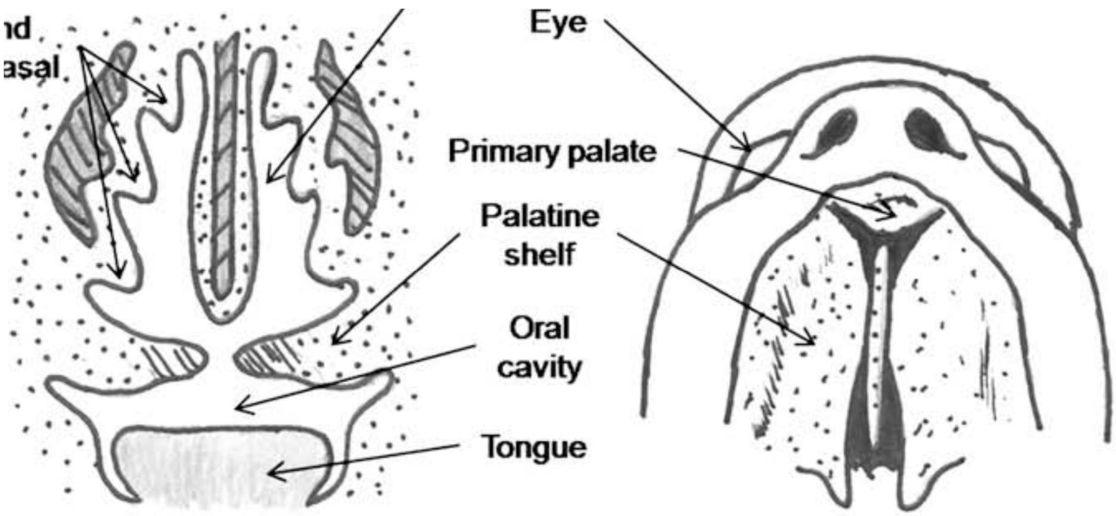


Fig 17: Development of turbinates

ANATOMY OF INFERIOR TURBINATE/CONCHA[1, 9]:

Inferior turbinate is a unique structure in the nose which forms a isolated bone. The surface is irregular which numerous pores scattered over it.

The vascular structure channels through these perforators on the surface covered by the mucoperiosteum. The turbinate has various processes articulating with the adjacent structures of which maxillary process articulates with the inferior margin of the maxillary hiatus. The other articulations are with the palatine bone, ethmoids and lacrimal bones where it continues as the medial wall of nasolacrimal duct. The turbinate owns a remarkable sub mucosal cavernous plexus associated with large sinusoids. The cavernous plexus contributes to the nasal resistance which is controlled by the autonomic nervous system. The lining epithelium is respiratory columnar epithelium. The maximum number of goblet cells are found over the anterior end of inferior turbinate (roughly 8 per mm square area) and reduces in number as we proceed posteriorly.

SURFACES:

1. Medial

2. Lateral

BORDERS:

1. Superior

2. Inferior

Medial surface:

- It is convex in architecture comprising enormous pores.
- It is navigated by longitudinal channels pass through the medial surface permitting vessels

Lateral surface:

- The concavity is towards the lateral surface and it lodges the inferior meatus

Superior Border:

- It is thinner and related to several bones alongside the lateral wall of the nose.

Superior border is divided into three parts:

- The anterior part is in articulation with the conchal crest of the maxilla.
- The posterior part is in articulation with the conchal crest of the palatine.
- The middle part comprises three well defined processes

- Among which, lacrimal process (anterior process) is small and pointy and is located at the confluence of the anterior one-fourth and the posterior three-fourths of the turbinate. It has articulation with the lacrimal bone. The lacrimal process of inferior turbinate also articulates with the frontal process of maxilla which forms the canal for nasolacrimal duct.
- The ethmoidal process is situated behind the lacrimal process and it is broader and thinner. It projects upwards to join the uncinate process.

- The maxillary process is a thin lamina which turns laterally and downwards. It articulates with the maxilla and contributes a little to form the medial wall of the maxillary process.

Inferior border:

- The inferior border of the turbinate has no articulations
- It is thicker and more cellular in architecture which is more pronounced in the mid-portion of the bone.

INFERIOR MEATUS[1]:

The inferior meatus is situated lateral and below the inferior turbinate occupying the lateral wall of the nose. It is the largest of all the meati. It extends from the anterior to posterior end of the nasal cavity. The highest part of the meatus is at the intersection of the anterior one-third and middle one-third. It measures about 1.6 to 2.3 cm high, the mean height being 1.9 cm.45 This is the usual area where the nasolacrimal duct opens into the inferior meatus. True valve is absent. The opening is closed only by small folds of mucosa. With the aid of endoscope, this can be appreciated in subjects by applying gentle pressure over the lacrimal sac at the level of medial canthus.

MICROANATOMY[1]:

Resistance involves arterioles and arteries, and capacitance involves venules and sinusoids. Shunting of blood occurs between the arteries and veins in the deeper part of the mucosa. It detours the superficial vessels and hence diminishes the volume of blood within the system. Anastomotic arteries spring upward via the cavernous plexus of veins and this is the place accounting for majority of the shunting. Along the surface of the mucosa, arteries subdivide into arterioles which are devoid of an elastic lamina and terminate in capillaries, that course parallel and immediately beneath the surface epithelium. They also route across mucosal glands.

Capillaries channel into a superficial venous system. They are best appreciated just before the superficial veins drain into venous sinusoids. Venous sinusoids are a complex of cavernous plexus consisting of enormous tortuous and anastomotic veins deprived of valves. Arterial as well as venous blood is drained into sinusoids. Blood flow is controlled by cushion veins which possess a longitudinal muscle coat. The lumen is not occluded completely but the veins regulate the blood flow into turbinate bone by means of deep venous plexus. The major feeding vessel being the maxillary artery, the blood flow is advanced through the nasal cavity. ‘Pseudo erectile’ is what they name for the vascular arrangement in the turbinates since it has much resemblance to the vascular supply of the penis.

PHYSIOLOGY RELEVANT TO INFERIOR TURBINATE[1]:

Respiratory epithelium mainly consists of ciliated and nonciliated pseudostratified columnar cells, basal pluripotential stem cells and goblet cells. An individual cell possesses microvilli which are 300-400 in number. Cilia will widen the surface area and hence prevents the mucosa from going dry. Each cell may account for around 50-100 cilia. They consist of nine peripheral doublet and two central single microtubules. Each peripheral pair attaches to the adjacent doublet and to the central microtubule with the aid of hexin links. It has dynein arms. ATPase is present in the dynein arms and it helps in ciliary beat movement.

AIRFLOW DURING INSPIRATION:

The airflow is directed upwards and backwards from the nasal valve initially, mainly over the anterior part of the inferior turbinate. It then splits into two, below and over the middle turbinate, re-joining into the posterior choana. Air reaches the other parts of the nose to a lesser degree. The velocity at the anterior valve is 12-18 m sec - 1 during quiet respiration.

NASAL AIRWAY RESISTANCE:

The nose accounts for up to half the total airway resistance. The nasal resistance is produced by two resistors in parallel and each cavity has a variable value produced by the nasal cycle. The resistance is made up of two elements; one essentially fixed comprising the bone, cartilage and attached muscles, and the other variable, the mucosa. The nasal resistance is high in infants who initially are obligatory nose breathers. Adults breathe preferentially through the nose at rest even though there is a significant resistance.

THE ANTERIOR NASAL VALVE:

It is the narrowest part of the nose and is less well defined physiologically than anatomically. Since it is narrowest part of the airway and so the greatest resistor, it produces the most turbulent airflow. It is formed by the lower edge of the upper lateral cartilages, the anterior end of the inferior turbinate and the adjacent nasal septum, together with the surrounding soft tissues.

NASAL CYCLE:

The cycle consists of alternate nasal blockage between passage. The changes are produced by vascular activity, especially the volume of blood on the venous sinusoids (capacitance vessels). Cyclical changes occur between four and 12 hours. It is constant for each person.

ULTRASTRUCTURE OF CILIA:

Cilia originate over the surface of epithelial cells spread over the lining of the respiratory tract. The function of cilia is to propel the mucus blanket backwards in the nasal cavity en route for the nasopharynx. Differing from the other cilia, nasal cilia are comparatively shorter with 5 microns size and the number goes up to 200 in each cell. Each cilium consists of a surface membrane, which encompasses a systematized ultrastructure. There are nine pairs of microtubules in the outer table surrounded by one inner pair of microtubules. The microtubules in the outer circle are interconnected with the help of nexins. They are also linked to the inner central pair of microtubules through central spokes. Each microtubule in the outer pairs comprises of two arms, outer and inner dynein arms, which entail an ATPase. In Kartagener's syndrome, the ATPase is lost. Microtubules become the basal body in the cell. The outer pair of microtubules develops into triplets whereas the inner pair vanishes. The outer microtubules are analogous to the centrioles present in mitotic cells. It has been put forward that centrioles migrate to reach the cell surface to create these structures. The mucus film is arranged in two layers. The upper layer is more viscous and the lower layer is more watery which is where the cilia can move generously. Small hooks are present over the tips of the cilia into which enter the upper viscous layer to move the same.

<u>CILIARY ACTION</u>:

The cilia beat at a frequency at the range of 7 to 16 Hz at a given body temperature of 22 degree Celsius. The cilia beat is constant when the temperature stays between 32 and 40°C. Ciliary beat involves a propulsive stroke which is the rapid phase and a recovery phase which is the slow phase. Throughout the propulsive phase, the cilium remains straight and the tip of the cilium projects into the viscous layer of the mucus film. In the recovery phase, the cilium slide over the aqueous layer. Here, ATP is converted to ADP with the aid of ATPase present in the dynein arms and thereby energy is generated. This reaction is Mg2 + ions dependent. The ciliary motion is initiated when the outer pair of micro tubules slides with respect to each other. The mitochondria located near surface of the cell adjacent to the basal bodies of the cilia are the ATP generating sources, well known as the power house of the cell. The nasal mucus blanket is pushed posteriorly by metachronous movement of the cilia. And only those cilia which are at right angles with respect to the direction of flow are in phase. The rest of the cilia which are in the direction of flow are somewhat out of phase up until the whole cycle is finished. The mucus blanket streams from the anterior part of the nasal cavity towards choana posteriorly. Those from the sinuses join that rolling on the lateral wall of the nose. The majority of mucus passes through the middle meatus which in turn flows across the Eustachian tube orifice and this is then swallowed.

FACTORS AFFECTING CILIARY ACTION:

The nasal cavity has a constant environment and therefore changes will disturb the normal functioning of the cilia. An important factor affecting ciliary motility is drying of the nasal mucosa. When there is a temperature variation below 10°C deg or above 45°C, the ciliary cease to move. Isotonic saline preserves ciliary activity whereas greater than 5 percent and less than 0.2 percent solutions produce paralysis. Except for non-physiological levels, potassium ions don't really have an impact on ciliary function. Likewise, ciliary beat is not altered above a pH value of 6.4 and the function is retained in faintly alkaline fluids with pH of 8.5 for a long duration of time. The epithelium lining the respiratory tract can be destroyed so much that it sloughs away with an episode of Upper respiratory tract infection. As the age increases,ciliary function wanes .

PROTECTION OF THE LOWER AIRWAY:

IMMUNOLOGICAL

Mucus encompasses a sum of different compounds capable of neutralizing antigens. This takes place either by innate mechanisms or acquired immunological responses. IgA and IgE are chiefly surface immunoglobins. When the mucosa is penetrated, IgG and IgM come for rescue. A number of bacterial allergens are counteracted but quite a few bacteria and viruses necessitate the initiation of the cell-mediated immune reactions. T and also a few B cells interact with macrophages. Antigens are regularly presented to the T lymphocyte cells with the aid of macrophages and dendritic cells. Dendritic cells are hold importance in the process of allergic reaction. Cytokines promote its action on CD4 + T lymphocytes. This in turn leads to two foremost responses- Th 1 and Th2 allergic response. The local lymphatic structure is usually split up into two, the mucosal associated lymphoid tissue (MALT) – the adenoids, tonsils, the lymphoid aggregations accumulated within the respiratory mucosa and the lymph nodes.

NONSPECIFIC IMMUNITY:

A nonspecific innate immunity is produced when lysozymes, Lactoferrin, anti-proteases, complement and other macromolecules come to interact with those bacteria lacking capsules. Macrophages and polymorph leukocytes involve in phagocytosis and abolish foreign substances. Quite a number of organisms and viruses are resistant and hence specific reactions are necessary.

ACQUIRED IMMUNITY:

IgG stimulates complement and subsequently leads to lysis of the cell and phagocytosis. Mycobacteria and viruses initiate cell-mediated immunity.

Nasal secretions comprise more of IgA which is a dimer. IgA dimer is transported passively via interstitial fluid. It is then actively engulfed by the seromucinous glands. IgA is attached stable in the mucus by means of the secretory factor in nasal epithelium. An insoluble complex is formed when IgA combines with an antigen, which is then swallowed and demolished by gastric acid. IgA never triggers complement.

IGE:

IgE is the major immunoglobulin involved in allergic reactions. In 1967, it was first acknowledged by Ishizaka. It is formed largely in lymphoid aggregates like adenoids and tonsils and also within the submucosa. IgE is firmly adherent to mast cells and basophils. Mast cell degranulation occurs when two molecules of IgE which are specific to an allergen attach themselves to receptor sites.

SURFACE CELLS:

Mucus contains epithelial cells, leukocytes, basophils, mast cells and macrophages. Macrophages and leucocytes find major role in phagocytosis and assist in preventing bacterial or viral invasion. Surface cells migrate through the interstitium from the blood. The vascular anatomy was defined elaborately by Burnham in the year 1935. Microanatomy has been further described by Cauna in a detailed manner. The nose lacks the constricting smooth muscle. Hence variations in airway are created by adaptations in blood flow and due to pooling of blood in capacitance and resistance vessels. Each site in the nasal cavity has a varying degree of development. It is most complex over the turbinates.

THE HYPERTROPHIED TURBINATES:

Various methods and techniques evolved in the management of hypertrophied turbinates both medically and surgically in the late nineteenth century. The diagnosis of enlarged turbinates carried out by exclusion criteria since no proper definition existed to quantify in regards of objective measurement. Moreover, diagnosis is obtained often retrospectively on the basis of treatment modality given for the patient for altered airway patency.

We do not know for sure whether the causal factor is the bone or mucosa as both can be enlarged. It is difficult to ascertain which is pathologic and which one is normal for a given patient. Hence there remains a controversy in the treatment of symptomatic subjects. As it is well defined that the enlargement of the nasal mucosa occurs as a part of normal physiology and this is referred as the nasal cycle. It indicates that the periodical change may be fluctuating from side to side as well modify simultaneously in both nasal cavities or in the worst case it may be totally irregular.

These routine cyclical changes occur especially over the inferior concha. It also takes place in the mucosa of middle turbinate, over the septum and also the ethmoid sinus.

The degree of hypertrophy is enhanced by infection and allergic rhinitis. The rhythm of the nasal cycle is changed by the topical applications like steroid nasal drops and the vasoconstrictors.Why these periodical changes happen is yet an unsolved topic. The is not enough data available to substantiate a normal swelling.

INFERIOR TURBINATE AND RHINOPLASTY:

Evidences exist stating that aesthetic reduction rhinoplasty brings about a change in the internal dimensions of the nasal cavity. And the main cause is altering the position of the inferior concha[10, 11]. The inferior turbinate is considered relatively enlarged in regards to the internal dimensions of the nose after surgery. On the other hand, there was one study which said that despite the fact where nearly 100 percent of the cases showed reduction of the nasal dimensions, only about 8 percent developed nasal obstruction after a period of six months following surgery[11]. To the contrary the nasal obstruction may recur over a long term. As the controversy follows, still quite number of surgeons while performing reduction rhinoplasty routinely does inferior turbinate surgery to avoid nasal obstruction postoperatively. The lack of knowledge in deciding what is normal regarding the bony and mucosal aspects of the nasal cavity explains controversy.

It is been recommended that the following conditions are regarded as useful indications for performing inferior turbinoplasty in patients undergoing aesthetic reduction rhinoplasty:

- narrow bony dimensions of the anterior part of the nasal passage
- mucosal congestion affecting the anterior end of the nasal cavity
- The identification of nasal obstruction in preoperative period.

INFERIOR TURBINATE AND SEPTOPLASTY:

In the current era, anterior septal deviations along with nasal obstruction are treated by septoplasty. There arises a controversy of turbinate reduction in this scenario. When there are septal deviations, as a part of developmental process, the bony part of inferior turbinate and middle turbinate enlarge on the maximal side of the nasal cavity opposite to the direction of deviated septum. The causes for septal deformities are either congenital in origin as in the case of cleft palate or due to trauma which happened during childhood. This is called compensatory hypertrophy of the turbinate. It can be either mucosal or skeletal. The existence of inferior turbinate hypertrophy has been proved objectively. But the evidence that it must be managed as a auxiliary procedure to septoplasty is lacking. A Randomized controlled study14, 15 revealed no benefit from turbinate reduction on the contralateral side to a deviated septum.

There is no study clarifying if the mucosal congestion is a factor common to cases with nasal obstruction due to deviated nasal septum or simply secondary to a deviated nasal septum. The controversy remains as to when to perform septoplasty alone and when to do inferior turbinoplasty since there is only 70% [12, 13, 14, 15] subjective satisfaction rate after some months following mere septoplasty and 43% percent at the end of 5 years 15.

Reports from various studies reported good results for nasal obstruction assessed subjectively in more than 90 percent of cases, following inferior turbinoplasty in cases of minimal or no septal deviation, both in the short and long term.

The recommendations made for the cases of septal deviation with nasal obstruction are as follows:

- The degree of obstruction in both nasal cavities as well as the mucosal congestion established
- Grossly evident deviated nasal septum must be corrected by septoplasty.
- Other aetiologies may be involved in minimal septal deviations and minor signs of mucosal congestion. Allergy, Infection or hypersensitivity should be borne in mind. Surgical reduction of the inferior turbinates should be considered when the medical management is not convincing

and the objective measurements imply minimal nasal dimensions anteriorly.

SNORING AND SLEEP APNOEA:

The different body positions bring changes in the patency of nasal airway. While the patient lies down, there is well defined reduction in the patency of airway. We have documented evidence that made comparison with normal subjects and hence proving that the postural change in nasal resistance is much pronounced in cases with allergic rhinitis[16] . Also, in sleep and awake states, the recumbent position in non-apnoeic snorers reduces nasal airway patency[17], while reviewing one study, [18] we could find that there had been very high nasal resistance as well as abnormal curves in acoustic rhinometry in more than 90% of a group of snorers. This implies inferior turbinate engorgement. Snoring is noticed more often in patients with nasal obstruction. when inferior turbinoplasty is done for these patients , the frequency curve of snoring may fall down. Continuous positive airway pressure has come along as the treatment for quite a number of patients who suffered from obstructive sleep apnoea.

However devices for CPAP produce bothersome nasal obstruction. This is perhaps an enhanced vasomotor responsiveness, ancillary to the usage of CPAP. Local steroid applications may benefit, [16] however are not constantly effective in regulating inferior turbinate congestion. There is no significant proof that turbinate surgeries are an advantage over a long run.

CHRONIC RHINITIS AND RHINOSINUSITIS:

Nasal obstruction is repeatedly the leading symptom in chronic infection and inflammation associated with nose and paranasal sinuses. Vascular engorgement of the nasal cavity is the characteristic feature associated with the inferior turbinate enlargement along with its well-organised vascular arrangement. Allergic rhinitis, antidepressants,pregnancy, rhinitis medicamentosa because of prolonged use of topical vasoconstrictors are other diagnoses which are to be considered in patients presenting with chronic nasal obstruction -(CNO).

The collection of CNO comprises a variety of physiologic and pathologic conditions and to be precise CNO is essentially not a surgical ailment. There are no established classifications of indications for inferior turbinate reduction surgery with the exception of the subjective sensation of compromised nasal airway patency, where surgery is implemented. In an effort to define the term CN0 18 on the basis of acoustic rhinometry factors, mucosal congestion was found in 76 % of subjects having CNO, one-third with bilateral involvement and two-thirds with unilateral involvement. Whether the turbinates are strictly irretrievably enlarged, briefly engorged owing to disruption of the normal anatomy of nasal mucosa or they are swollen in relation to the skeletal dimension of the nasal cavity especially the anterior most part are the interrogations that make the specific clinical diagnosis of enlarged turbinates challenging in practice.

Nonetheless, various studies demonstrate inferior turbinate reduction surgery to be effective in over 90 % of subjects in dismissing the chronic nasal obstruction intractable to medical treatment. The techniques used are abundant and the long-term outcome is inconstant from weeks, months to years. One controlled randomized studyl9 recommends submucous resection of the inferior turbinate plus outfracturing of the inferior concha are satisfactory for a longer period of time, with limited side effects on the nasal mucosa

In chronic rhinosinusitis , there may be enlargement of inferior turbinate secondary to the infection affecting the middle meatus. Conversely, the current outlook suggests that the enlargement retrocedes once infection in the sinus has been treated. Stammberger[18] states that he barely performs reduction of the inferior turbinate reduction surgeries in chronic rhinosinusitis. Sometimes, the choana is occluded when the posterior end of the inferior turbinate is persistently engorged. In this circumstance, excision is warranted with a surgical snare.

While concha bullosa (pneumatisation of the middle turbinate) being a common anatomical variant, the inferior turbinate is hardly ever pneumatised.

The ensuing are acclaimed as practical indications for implementation of inferior turbinate reduction surgery in patients with chronic nasal obstruction. The candidates are ought to satisfy each of the following requirements:

- No signs of infection in diagnostic nasal endoscopy
- No response to medical management of sufficient interval.

MEDICAL TREATMENT:

Intranasal topical corticosteroids are most commonly used as the first-line of drug in treating nasal obstruction, on condition that tumors and abnormal skeletal deformities have been eliminated. There were around 100 placebo-controlled, double blinded studies[19] which have exposed the efficiency of topical intranasal corticosteroids on nasal obstruction, rhinorrhoea, sneezing which are the predominant symptoms in allergic as well as non-allergic rhinitis. The steroids when compared with the antihistamines have a better efficacy. Vasoconstrictors are also used for the similar purpose and should be made sure that patients are aware of the long term risk of acquiring rhirtitis medicamentosa. Isotonic saline nasal spray is also recommended as an adjunctive for the management of chronic nasal obstruction.

SURGICAL TREATMENT:

The surgical solution for inferior turbinate hypertrophy has been in debate for over a period of 100 years. The concentration has been employed more on technical developments of the recent era. The evidence promoting the effectiveness of various procedures remains controversial. The objective of any taken surgical treatment of the inferior turbinate hypertrophy is to improve nasal blockage and to elude complications in the short and long term. The classification of various surgical procedures of turbinate reduction falls into destructive procedures, mechanical procedures and turbinate resection procedures.

The complications include haemorrhage- primary or secondary, crusting and post-operative synechiae formation. The reviews weighing the benefits and risks of the different techniques propose an extensively conflicting recommendations. In one review it is stated turbinate reduction assisted by LASER is intensely supported for the reason that it gives fairly effective outcomes with minimally associated morbidity[20]. To the contrary, the other review established that chemocautery, electrocautery, partial turbinectomy, LASER surgery and cryosurgery should not be practised as these procedures are very destructive but intraturbinal turbinate reduction would appear to be the technique of choice[21]. In the period between these reviews, the first prospective randomized study comparing sub mucosal resection (with and without lateral displacement), cryotherapy, electro cautery, LASER cautery and subtotal turbinectomy was published. The same study contributes wide-ranging objective results where the surveillance period was taken from one to four years. The submucosal resection of inferior turbinate performed along with lateral displacement of the bone accomplishes a long-term enhancement of the nasal passage with stabilisation of the mucociliary clearance time and also with less bleeding in the post-operative period.

METHODS OF INFERIOR TURBINATE REDUCTION:

(In the chronology of Appearance)

Table 1: Methods of Inferior Turbinate Reduction

S.NO	METHODS OF SURGERY	YEAR
1	Thermal coagulation, Electrocautery	1845-1880
2	Chemocoagulation	1869-1890
3	Turbinectomy	1882
4	Lateralization	1904
5	Submucous resection turbinate bone	1906-1911
6	Partial resection	1930-1953
7	Corticosteroids Injection	1952
8	Sclerosing agents Injection	1953
9	Vidian neurectomy	1961
10	Cryosurgery assisted turbinate reduction	1970
11	Turbinoplasty	1982
12	LASER cautery	1977
13	Powered instruments like microdebrider	1994
14	Radiofrequency assisted turbinate reduction	1998
15	Argon plasma method	2002

INFERIOR TURBINOPLASTY:

The surgical procedure aims at minimizing the size of the inferior turbinates when patients become intractable to conservative medical treatment. During previous times, reduction of the turbinates was executed by applying different methods comprising cautery, laser reduction, steroid injection, cryosurgery or conventional surgical resection. The disadvantages faced in these techniques were unable to deliver long-term relief as in steroid injections and cryosurgery or were related to elongated recovery time or prolonged nasal crusting as in cautery, surgical resection and laser. Lately, newer techniques were established to preserve normal functioning of the mucus membrane covering the turbinate while still permitting for turbinate reduction.

Powered inferior turbinoplasty make use of specialized equipment known as microdebrider. This small rotating blade is positioned beneath the mucus membrane of the turbinate to get rid of the extra substance of the inferior turbinate from within. This procedure has a lot of benefits like almost complete removal of turbinate bulk and a rapid healing phase compared with rest of the methods. Microdebrider assisted inferior turbinoplasty is done in many centres as an outpatient department procedure consuming only 20 minutes on the whole.

Coblation assisted inferior turbinate reduction is done by introducing a radiofrequency probe in the sub mucosal plane to reduce the underlying turbinate. This technique takes less than ten minutes and provides the advantage of Outpatient procedure.

Coblation as well as microdebrider assisted inferior turbinoplasty cause only slight discomfort in post-operative period. These are the techniques which bring about significant improvement in nasal obstruction for those patients suffering from chronic disease. Many patients with sleep apnoea finding CPAP devices difficult to handle do benefit from these procedures.

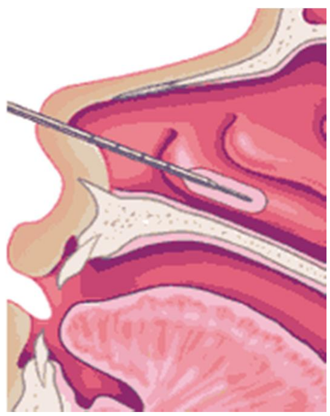


Fig no. 18 Coblation turbinoplasty

SUBMUCOSAL DIATHERMY:

The foremost technique being followed through all the years along is monopolar diathermy for inferior turbinate reduction surgeries[22] .

There is increase in thickness of the mucosa in patients with inferior turbinate hypertrophy which could be attributed either to hypertrophy of the lamina propria that contains inflammatory cells, venous sinusoids and mucosal glands or because of increase in the skeletal dimensions of the inferior turbinate[22-24]. SMD is beneficial only in patients presenting with inferior turbinate hypertrophy whose reason being increased submucosal tissue. When it is just the bone which is involved this procedure doesn't help much[25] .

Hence the candidate selection for inferior turbinate reduction must be on the basis of patient's symptoms, clinical judgment of the surgeon and use of topical decongestants [26].

The principle of SMD is causing fibrosis of the submucosal tissue which is obtained by coagulation of the venous sinusoids within the turbinate[23, 27.] In SMD, an area of coagulation necrosis is formed along the electrode passage, which is replaced with sclerotic connective tissue providing a stable reduction of the enlarged turbinate[28, 29] .

HISTORY OF MICRODEBRIDER

The devices were used by the House group in the 1970s for acoustic neuroma excision. The original patent was held by Jack Urban[30.] In 1970s, orthopedic surgeons developed a microdebrider that was became used in arthroscopy. Setliff introduced debriders in Functional Endoscopic Sinus surgery in 1994[31, 32.]

MECHANISM OF MICRODEBRIDER

The microdebrider is a powered instrument that specifically resects tissue, minimal mucosal trauma and stripping. The term powered instrumentation refers to motor driven instrument that delivers suction and cutting action simultaneously. The complete surgical unit consists of a power unit and its Foot switch or pedal, a hand piece and a disposable blade.The blade (cannula) is made up of two parts an outer blunt tip with a lateral port and inner cannula also has a lateral port. The inner tube oscillates, and the outer tube is stationary. The inner blade oscillates in reverse or forward direction. The oscillating mode is, preferred which produced less pulling and tearing of tissue and subsequently causes less trauma.[33] The actual clearance or fit between the inner and the outer tube assemble must be close (0.05 mm) is critical to obtaining the clean cut. Edges of blades may be smooth or serrated . Microdebrider depends on shearing forces to resect tissues. Serrated edges are effective in cutting soft tissue than the continuos edges.The angle of the inner and outer blades produce either guillotine or scissor type of cutting. Guillotine type is less efficient than scissor cutting. Scissor cutting allows pinpoint cutting.[33] Oscillation typically yields a better cutting, faster removal of soft tissue than does rotation and minimizes pulling. Smaller diameter blades are more aggressive than larger diameter blades.The speed of hand piece motor is 500rpm. Force = torque/radius = torque/diameter/2 = 2(torque)/diameter Burr of various size are available. The selection of burr depends on diameter, geometry (e.g., spherical, acorn-shaped), the speed of rotation, the number of flutes, rake angle and helix[34] .

Suction part is provided in proximal end of the hand piece. Proper suction is must for effective use of microdebrider .Clogging of blades is prevented by placing in saline

The outer and inner cannula may be configured to resect tissueby a guillotiiie cut (A) or scissors cut (B). Scissors cutting is more efficient because it involves a"pinpoint cutting" action with a traveling plane of resection[35] in a forward direction. The oscillating mode is, preferred which produced less pulling and tearing of tissue and subsequently causes less trauma. The actual clearance or fit between the inner and the outer tube assemble must be close (0.05 mm) is critical to obtaining the clean cut. Edges of blades may be smooth or serrated . Microdebrider depends on shearing forces to resect tissues. Serrated edges are effective in cutting soft tissue than the continuos edges.The angle of the inner and outer blades produce either guillotine or scissor type of cutting . Guillotine type is less efficient than scissor cutting. Scissor cutting allows pinpoint cutting. Oscillation typically yields a better cutting, faster removal of soft tissue than does rotation and minimizes pulling. Smaller diameter blades are more aggressive than larger diameter blades.The speed of hand piece motor is 500rpm. Force = torque/radius = torque/diameter/2 = 2(torque)/diameter Burr of various size are available. The selection of burr depends on diameter, geometry (e.g., spherical, acorn-shaped), the speed of rotation, the number of flutes, rake angle and helix.

LIMITATIONS OF MICRODEBRIDERS:

1. Slow rotation rates – Debriders rotate at slow rates as compared to that of microdrills thus making it inefficient to drill bony structures.

2. Tactile feedback is less while operating with microdebriders when compared to that of conventional instruments

3. It should be used carefully in confined spaces close to vital structures in order to avoid damage to them.

4. Initial cost of equipment and recurring expenses incurred towards puschase of blade becomes costly[36].

PER-OPERATIVE FIELD VISIBILITY

The surgical field visbility was graded accordingly:

BOEZAART VANDERMERWE GRADING[7] :

Grade 1 – Cadaveric conditions

Grade 2 – Field is good with requirement of infrequent suctioning .

Grade 3 – Field is good only with frequent suctioning

Grade 4 – Field is not visible when suction is removed before the instrument can complete the task.

Grade 5 – Abandoning of surgery

POST OPERATIVE SCORING SYSTEM OF LUND KENNEDY:

1. Grading for Scarring:

    Grade 0 – absent

    Grade 1 – mild

    Grade 2 – severe

2. Grading for Crusting:

    Grade 0 – absent

    Grade 1 – mild

    Grade 2 – severe

VAS SCALE:

1 to 10; ranging from no pain (0) to worse pain ever (10); measured in centimetre scale.

PHYSICS BEHIND INFERIOR TURBINATE:

It is stated in Poiseuilles law[37] that even a smaller low increase (around 10%) in the cross sectional area of the nasal cavity causes a rise in airflow by 21%(2). The volume of the nasal passage increases by 35% when the nose is decongested.

UNIQUENESS OF INFERIOR TURBINATE:

The unique creation of inferior turbinate takes upper hand in the established functions of nose. The lining is pseudostratified columnar epithelium with enormous goblet cells[38] which spreads over a well-organised basement membrane. An array of arteries, arteriovenous anastomosis, and venous sinusoids are present in the submucosa. It also contains many secreting glands. The venous sinusoids situated between the capillaries and the venules are encased by smooth muscle fibres which is autonomic nervous system controlled. They have the property of vasodilatation and vasoconstriction depending on the physiologic needs of the body[39]. Hypertrophy of inferior turbinate[40] has an impact on airway and olfaction. The pathology causes deposition of collagen underneath the basement membrane of sinonasal mucosa, as well as hypertrophy and hyper secretion of mucous glands[41] .This calls for a surgical procedure where turbinoplasty is done to reverse the pathology and provide symptomatic relief.

<u>FOUR POINT SYMPTOM SCALES:</u>

It is necessary to grade and score the symptoms of inferior turbinate hypertrophy for subjective assessment pre- and post-operatively. The symptoms for which scoring is done are as follows:

1. Nasal obstruction
2. Nasal discharge
3. Headache
4. Hyposmia

They are done separately for each symptom and the total score is finally calculated for all the four symtoms

<u>Table 2: Four point scale for nasal obstruction:</u>

GRADE	NASAL OBSTRUCTION
0	No nasal obstruction
1	Mild obstruction (no disturbance in patient's daily life)
2	Moderate obstruction (necessitating for mouth breathing)
3	Severe obstruction (sleep disturbances & change in voice quality)

Table 3: Four point scale for nasal discharge:

GRADE	NASAL DISCHARGE
0	No nasal discharge
1	Mild nasal discharge (1 to 4 nose blowing a day)
2	Moderate nasal discharge (5 to 10 nose blowing a day)
3	Severe nasal discharge (continuous nasal discharge)

Table4: Four-point scale of headache:

GRADE	HEADACHE
0	No headache
1	Mild headache (not requiring use of any analgesics)
2	Moderate headache (requiring non-narcotic analgesics)
3	Severe headache (requiring narcotic analgesics)

Table 5: Four-point scale of hyposmia:

Scale	Hyposmia
0	No hyposmia
1	Mild hyposmia
2	Moderate hyposmia
3	Severe hyposmia

RESULTS AND OBSERVATIONS:

STATISTICAL ANALYSIS:

DNE grading, intraoperative field visibility , post-operative crusting as well as synechiae are qualitative data analysed and compared within groups using pearson chi-square tests. Analysis of Variance (ANOVA) was applied to measure mean and standard deviation for quantitative figures of four point symptom scale, duration of surgery, intraoperative blood loss. Intergroup comparisons within various groups were compared with ANOVA and Multiple Comparison Procedures (Tukey Test). P- value <0.05 was considered statistically significant.

- P value 0.000 to 0.010 is denoted by ** and implies Significant at level-1 (Highly Significant)
- P value 0.011 to 0.050 is denoted by * and implies Significant at level-5 (Significant)
- P value 0.051 to 1.000 implies not Significant at level-5 (Not Significant)

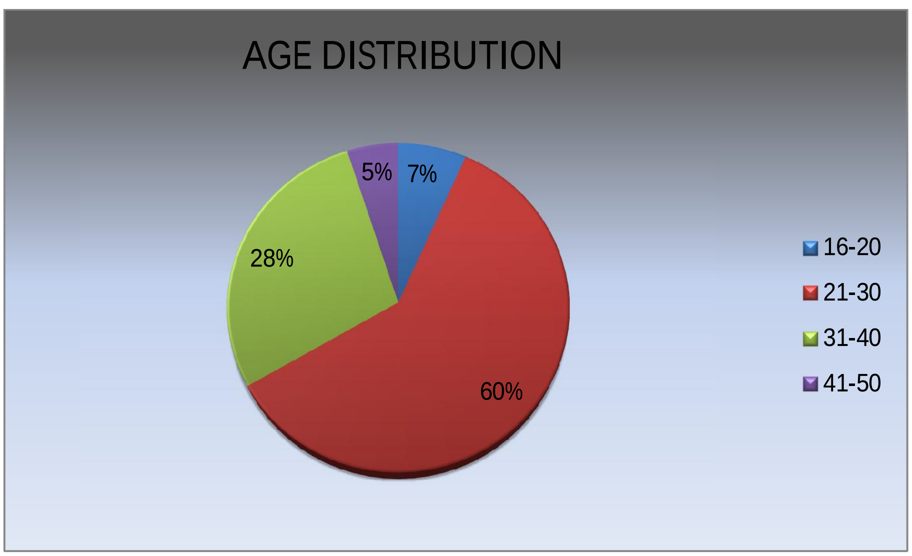
DEMOGRAPHIC DATA:

AGE DISTRIBUTION:

Table 6: Percentage of study population in different age groups

AGE GROUP(YRS)	FREQUENCY	PERCENTAGE
16-20	4	6.66%
21-30	36	60%
31-40	17	28.33%
41-50	3	5%

Chart 1:



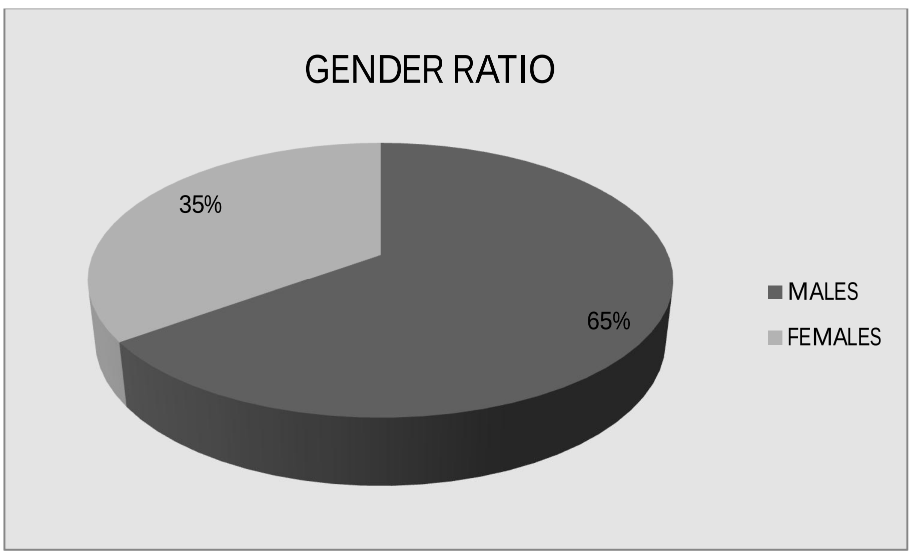
60% of the patients in the study are between 21 and 30 yrs of age and 28% are between 31 and 40 yrs. The adolescent and old age group pateints are less in number in the present study.

<u>GENDER RATIO:</u>

Table 7: Percentage of Gender Variation

GENDER	MALES	FEMALES
FREQUENCY	39	21
PERCENTAGE	65	35

<u>Chart 2:</u>



Most of the patients enrolled in the study were males with upto 65% of the total study population. The sampling is done in a consecutive non random method. The gender of the patient didn't have any impact on the various outcomes of the study.

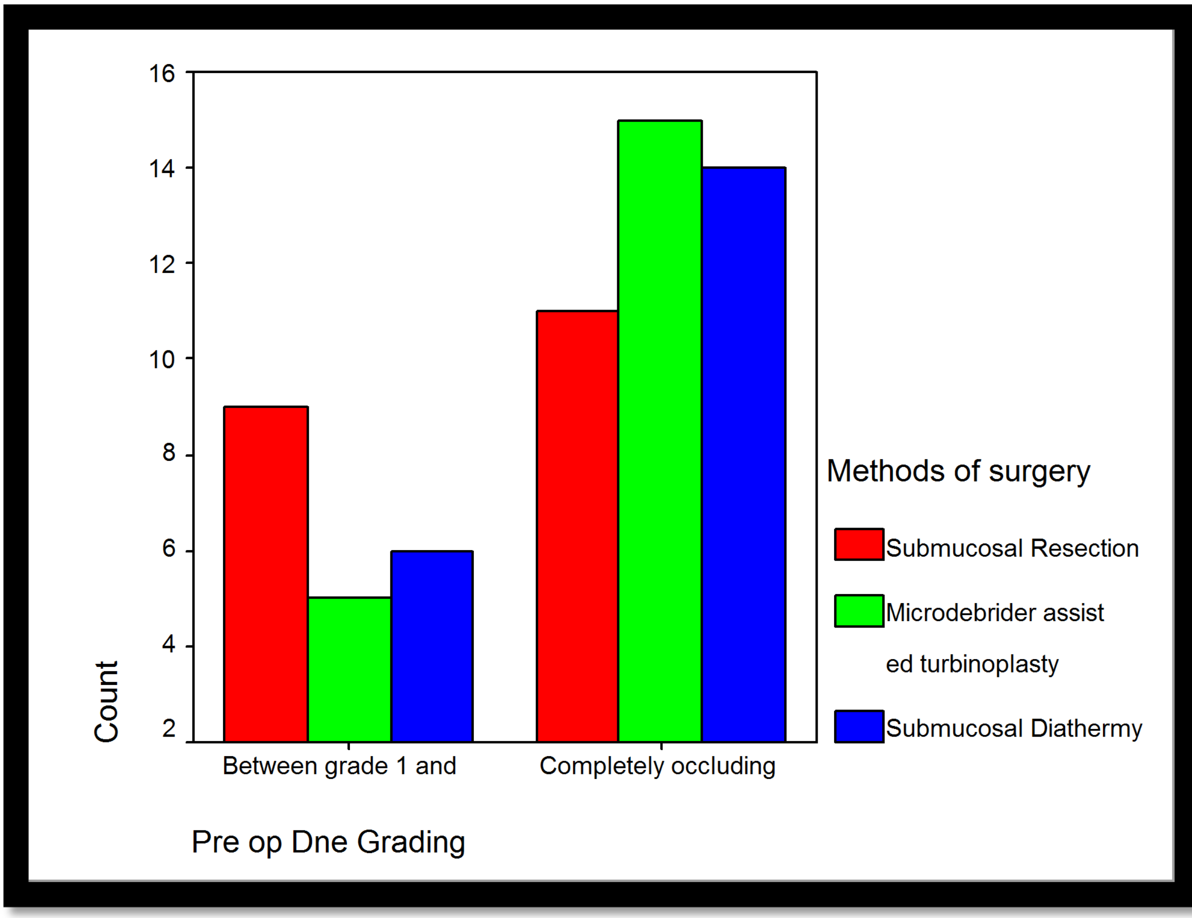
PRE-OP DNE GRADING OF ITH:

Table 8: Pre-op DNE grading of ITH (Pearson Chi-square tests)

PRE OP DNE GRADING		METHODS OF SURGERY		
		SMRIT	MAIT	SMD
GRADE 2	FREQUENCY	9	5	6
	PERCENTAGE	45.0%	25.0%	30.0%
GRADE 3	FREQUENCY	11	15	14
	PERCENTAGE	55.0%	75.0%	70.0%

PRE-OP DNE GRADING OF ITH:

Chart 3:



20 patients had grade 2 ITH chosen for surgery . Of which 45% underwent SMR,25% MAIT and 30% SMD

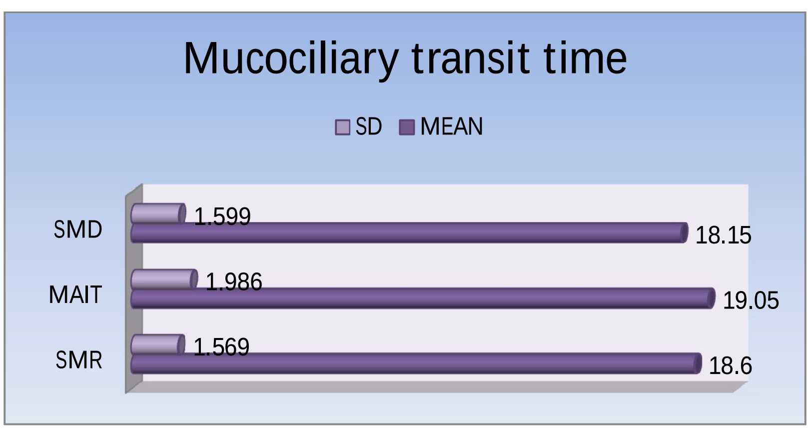
Remaining 40 pts had grade 3 ITH. Of which 55% - SMR, 75% - MAIT, 70% - SMD

MUCOCILIATY TRANSIT TIME- PREOPERATIVE SACCHARIN TEST:

Table 9: Preoperative Mucociliary Transit Time (Oneway ANOVA test)

DURATION IN MINUTES	N	MEAN	STD. DEVIATION	P VALUE
SMRIT	20	18.60	1.569	< 0.001
MAIT	20	19.05	1.986	
SMD	20	18.15	1.599	
TOTAL	60	18.60	1.739	

Chart 4:



Patients selected for SMRIT had a mean mucociliary clearance time of 18.60 min.MAIT had 19.05 min and SMD- 18.15 min

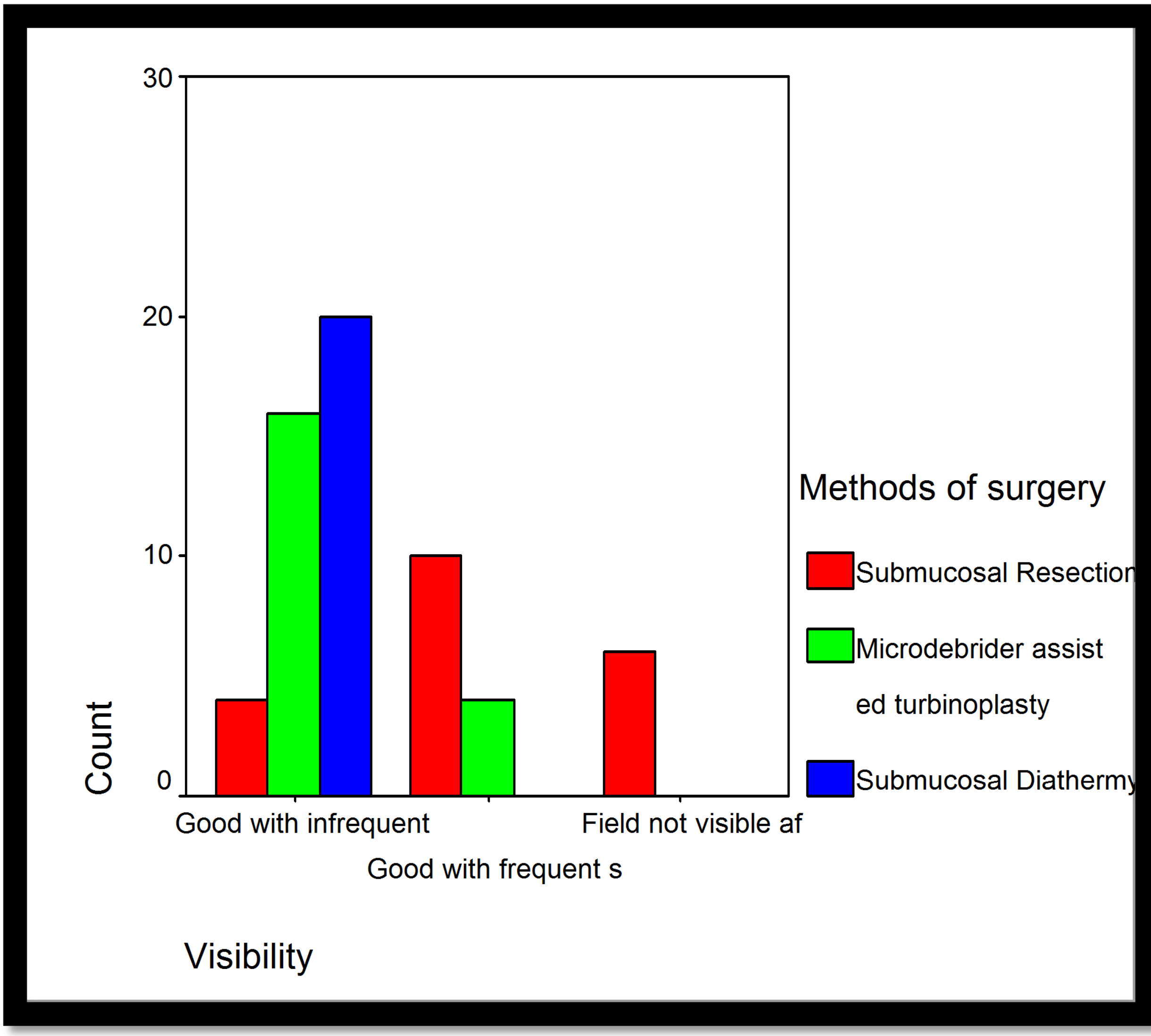
VISIBILITY OF OPERATING FIELD:

Table 10: Per operative visibility score (Pearson Chi-square tests)

PER OPERATIVE VISIBILITY SCORE		METHODS OF SURGERY			P VALUE
		SMRIT	MAIT	SMD	
GRADE 2	FREQUENCY	4	16	20	0.001
	PERCENTAGE	20.0%	80.0%	100.0%	
GRADE 3	FREQUENCY	10	4	0	0.001
	PERCENTAGE	50.0%	20.0%	.0%	
GRADE 4	FREQUENCY	6	0	0	0.001
	PERCENTAGE	30.0%	.0%	.0%	

VISIBILITY OF OPERATING FIELD:

Chart 5:



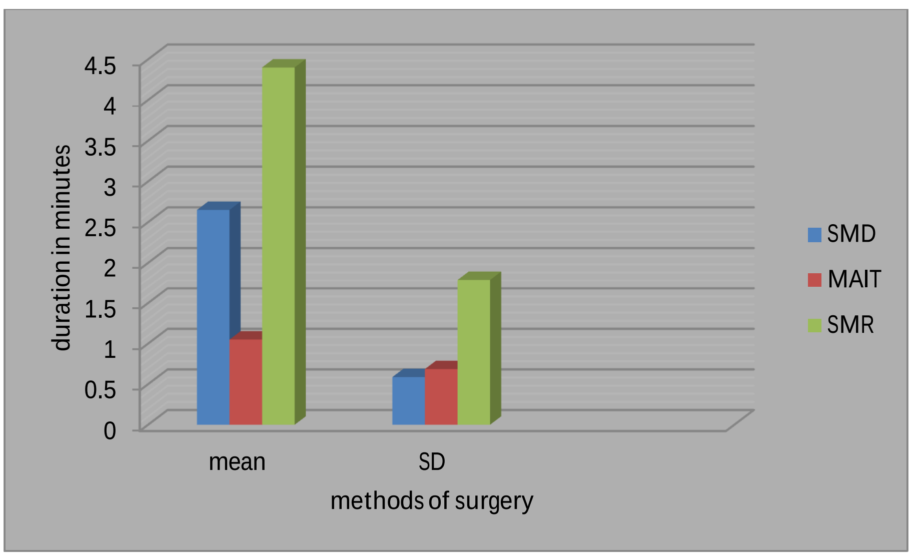
MAIT cases around 80% fall into grade 2. SMRIT cases of 50% falls into grade 3 and 30 % into grade 4.SMD all 100% cases come under grade 2.The p-value is 0.001 and it is highly significant. SMD has an overall better visibility of operating field during the procedure with no need of frequent suctioning

TIME REQUIRED FOR SURGERY:

Table 11: Duration of surgery in minutes (Oneway ANOVA test)

DURATION IN MINUTES	N	MEAN	STD. DEVIATION	P VALUE
SMRIT	20	36.60	3.939	< 0.001
MAIT	20	23.00	2.753	
SMD	20	10.15	1.843	

Chart 6:



SMRIT- 36.60 min

MAIT-23 min

SMD-10.15 min

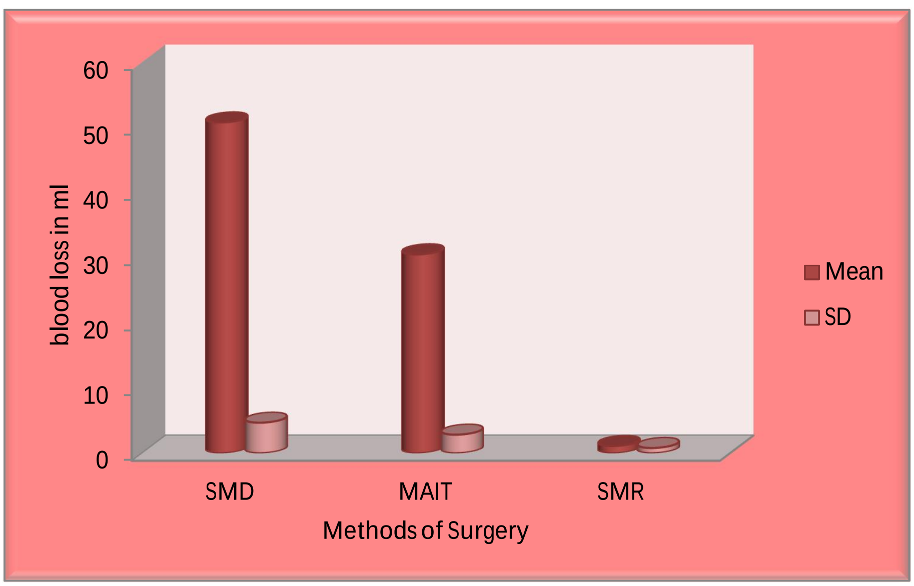
The results are highly significant, the p-value being <0.001

INTRAOPERATIVE BLOOD LOSS:

Table 12: Intraoperative blood loss (Oneway ANOVA test)

DURATION IN MINUTES	N	MEAN	STD. DEVIATION	P VALUE
SMRIT	20	50.80	4.675	< 0.001
MAIT	20	30.60	2.836	< 0.001
SMD	20	1.10	0.788	< 0.001

Chart 7:



Mean blood loss for SMRIT-50.80 ml; MAIT-30.60ml; SMD-1.10ml

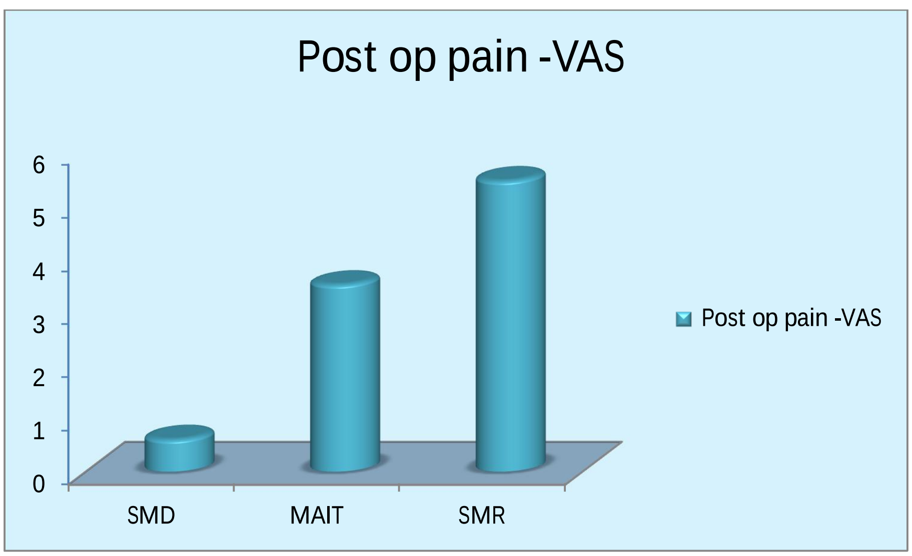
The blood loss is very minimal when SMD is performed. There is high significance in comparison of blood bloss due to three procedures done as the p-value being <0.001.

VAS SCALE FOR POST OP PAIN:

Table 13: VAS scale (One way ANOVA test)

METHODS OF SURGERY	N	MEAN	STD. DEVIATION	P VALUE
SMRIT	20	5.45	1.050	< 0.001
MAIT	20	3.50	0.946	< 0.001
SMD	20	0.60	0.598	< 0.001

Chart 8:



Average VAS scale for

SMD- 0.6

MAIT- 3.5

SMRIT- 5.45

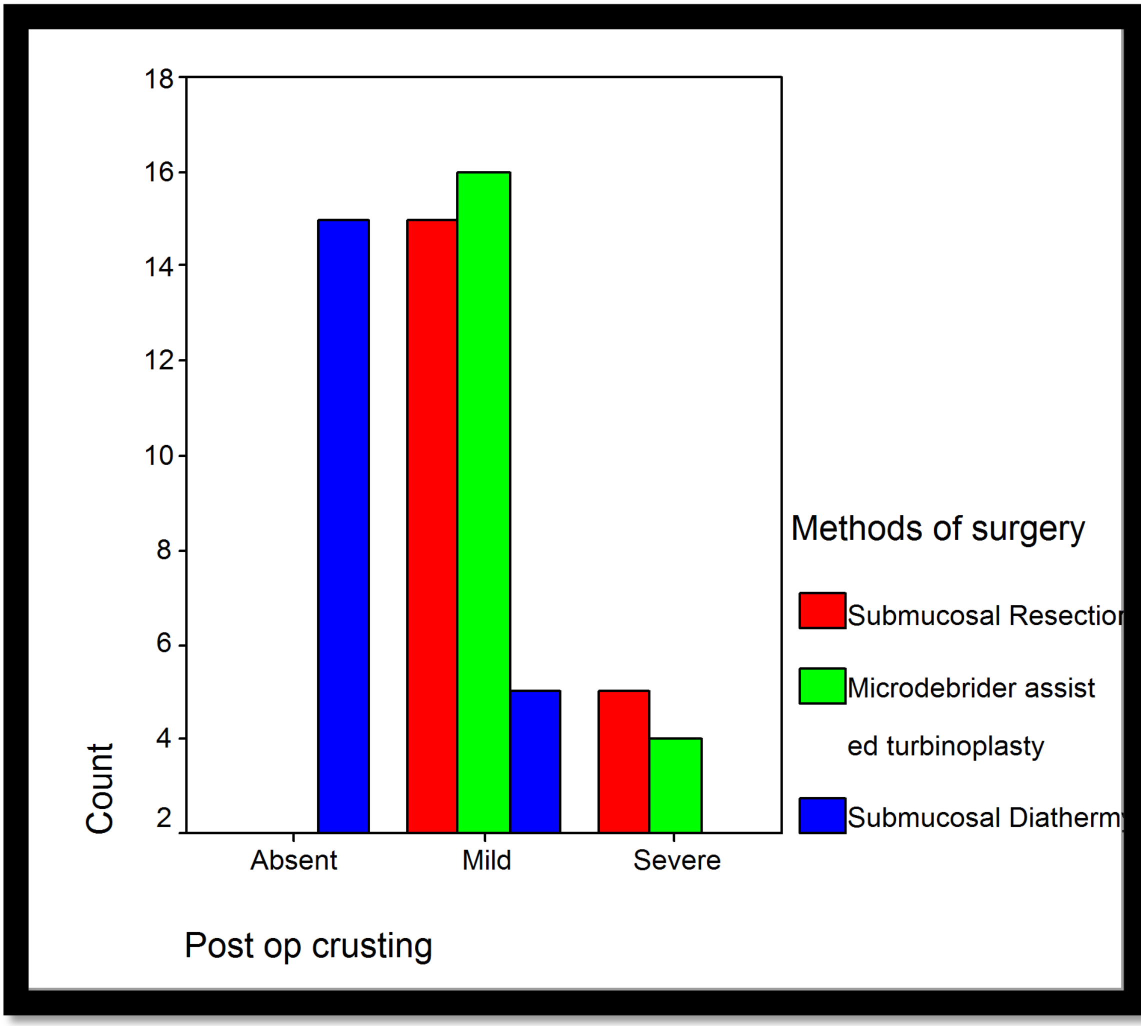
POST OP CRUSTING:

Table 14: Post op crusting(Pearson Chi-square tests)

POST OP CRUSTING		METHODS OF SURGERY			P-VALUE
		SMRIT	MAIT	SMD	
GRADE 0 (ABSENT)	FREQUENCY	0	0	15	0.001
	PERCENTAGE	.0%	.0%	75.0%	
GRADE 1 (MILD)	FREQUENCY	15	16	5	
	PERCENTAGE	75.0%	80.0%	25.0%	
GRADE 2 (SEVERE	FREQUENCY	5	4	0	
	PERCENTAGE	25.0%	20.0%	.0%	

POST OP CRUSTING:

Chart 9:



In the SMRIT group, 75% 0f patients had grade 1 crusting and 25% had grade 2 crusting. 80% of patients in MAIT study group had grade 1 crusting and 20% had grade 2 crusting. Whereas the crusting seen postoperatively in SMD patients account for only 25% in grade 1 and the remaining had no crusting.

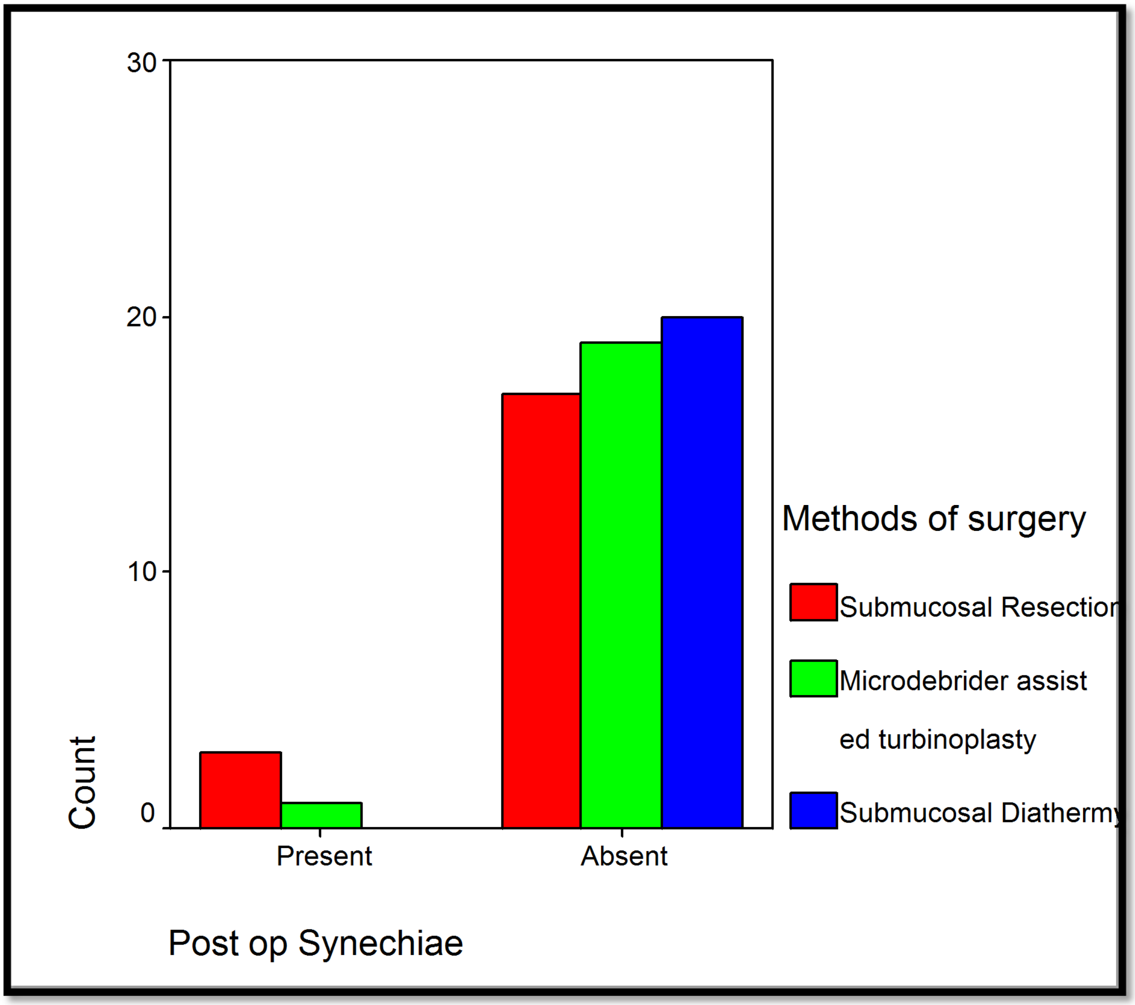
POST OP SYNECHIAE :

Table 15: Post op Synechiae: (Pearson Chi-square tests)

POST OP SYNECHIAE		METHODS OF SURGERY			P-VALUE
		SMRIT	MAIT	SMD	
PRESENT	FREQUENCY	3	1	0	0.153
	PERCENTAGE	15.0%	5.0%	.0%	
ABSENT	FREQUENCY	17	19	20	
	PERCENTAGE	85.0%	95.0%	100.0%	

<u>POST OP SYNCHIAE</u>:

<u>Chart 10:</u>



15% of SMRIT pts had post-operative synechiae. 5% of MAIT pts were witnessed with synechiae, whereas SMD group had no postoperative synechiae

POST OP FOUR POINT SYMPTOM SCALE:

Table 16: Post op Four point symptom scale (One way ANOVA test)

DEPENDENT VARIABLE	METHODS OF SURGERY	N	MEAN	STD. DEVIATION	95% CONFIDENCE INTERVAL FOR MEAN		P VALUE
					LOWER BOUND	UPPER BOUND	
POST OP FOUR POINT SCALE- VISIT I	SMRIT	20	5.85	.988	5.39	6.31	
	MAIT	20	5.60	1.142	5.07	6.13	
	SMD	20	6.90	.788	6.53	7.27	
	TOTAL	60	6.12	1.121	5.83	6.41	
POST OP FOUR POINT SCALE- VISIT I	SMRIT	20	3.40	.754	3.05	3.75	
	MAIT	20	2.55	.887	2.13	2.97	<0.001
	SMD	20	4.65	1.348	4.02	5.28	
	TOTAL	60	3.53	1.334	3.19	3.88	
POST OP FOUR POINT SCALE- VISIT III	SMRIT	20	2.65	.587	2.38	2.92	
	MAIT	20	1.05	.686	.73	1.37	
	SMD	20	4.40	1.789	3.56	5.24	
	TOTAL	60	2.70	1.788	2.24	3.16	

The mean values of four point symptom scale in SMRIT study group in post op visits 1,2 and 3 are 5.85, 3.40 and 2.65 respectively. That of MAIT group are

5.60, 2.55 and 1.05. The values for SMD are 6.90, 4.65 and 4.40. The reports show significant improvement of symptoms in all the study groups with the best results in MAIT study group.

Chart 11: (*** 1-SMD; 2-MAIT; 3-SMRIT series 1- mean; series 2- SD)

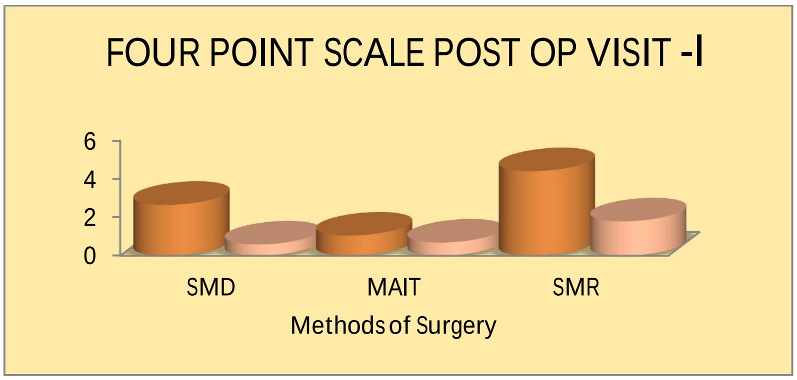


Chart 12: (*** 1-SMD; 2-MAIT; 3-SMRIT series 1- mean; series 2- SD)

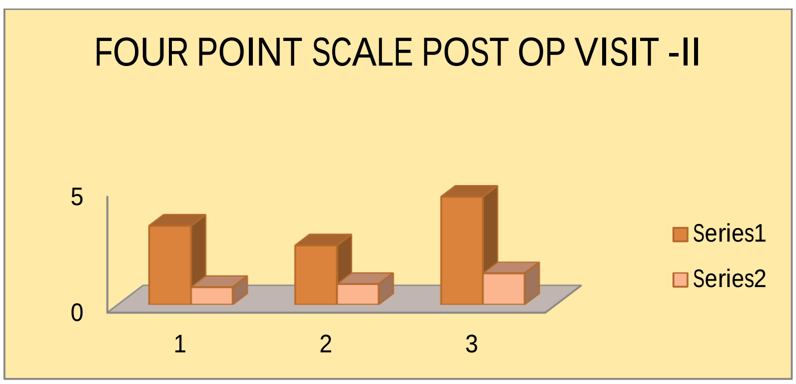
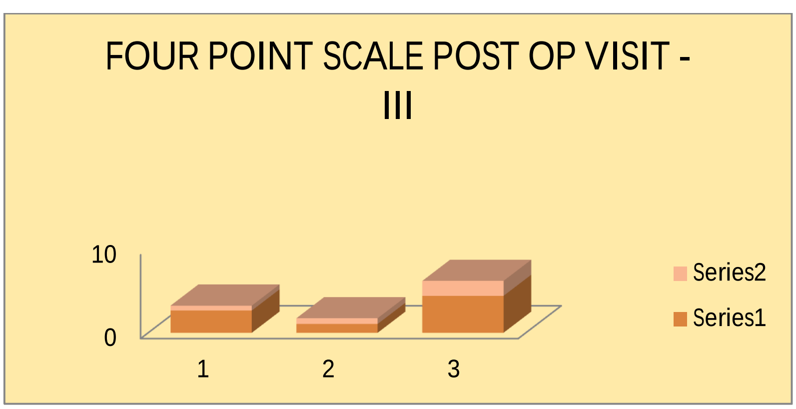


Chart 13: (*** 1-SMD; 2-MAIT; 3-SMRIT series 1- mean; series 2- SD)



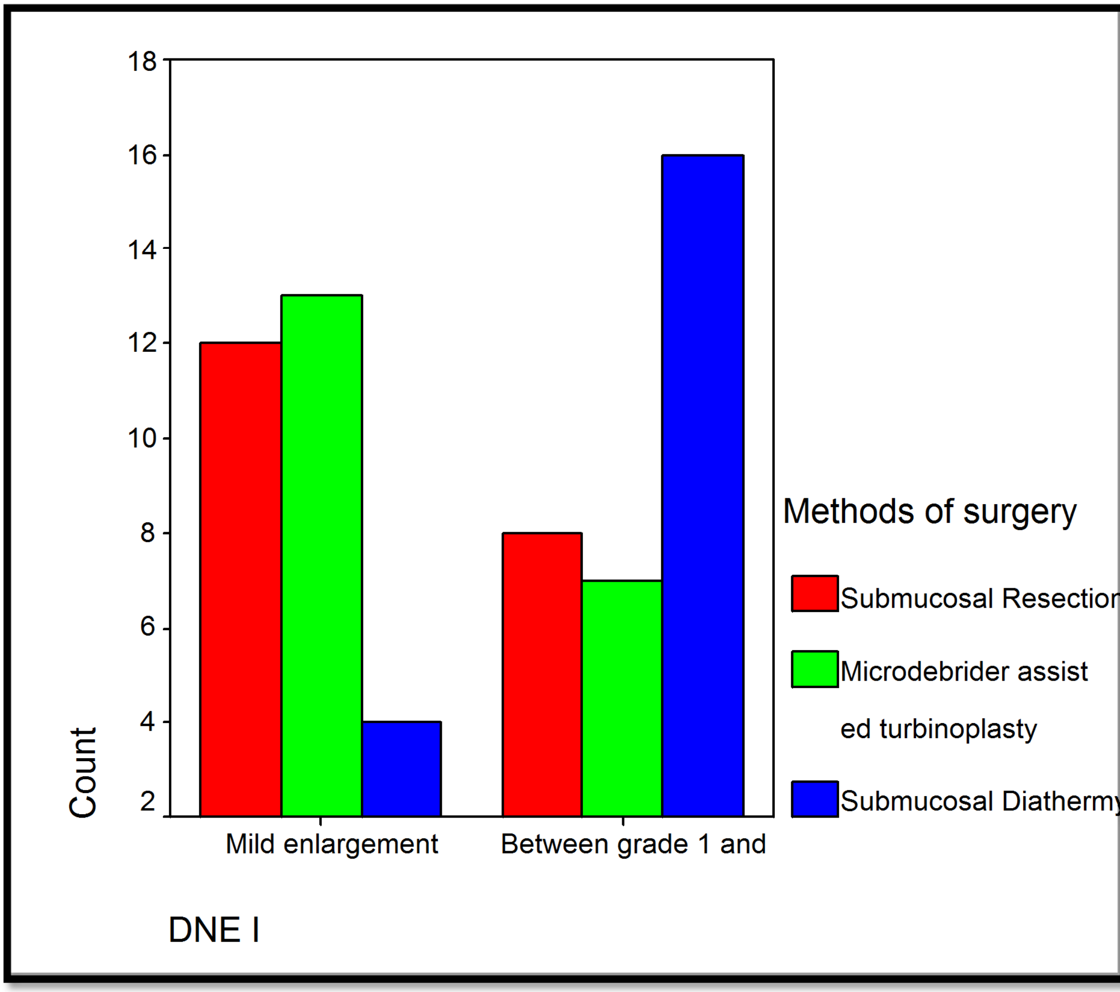
DNE ITH GRADING POST OP VISIT-I:

Table 17: DNE ITH grading Postop Visit- I (Pearson Chi-square tests)

DNE GRADING OF ITH		METHODS OF SURGERY			P VALUE
		SMRIT	MAIT	SMD	
GRADE I	FREQUENCY	12	13	4	0.008
	PERCENTAGE	60%	65%	20%	
GRADE II	FREQUENCY	8	7	16	
	PERCENTAGE	40%	35%	80%	

DNE ITH GRADING POST OP VISIT-I:

Chart 14:



SMRIT- 60% fall into grade 1 and 40% in grade 11

MAIT- 65% in grade 1 and 35 % in grade II

SMD- 20% in grade I and 80% in grade II

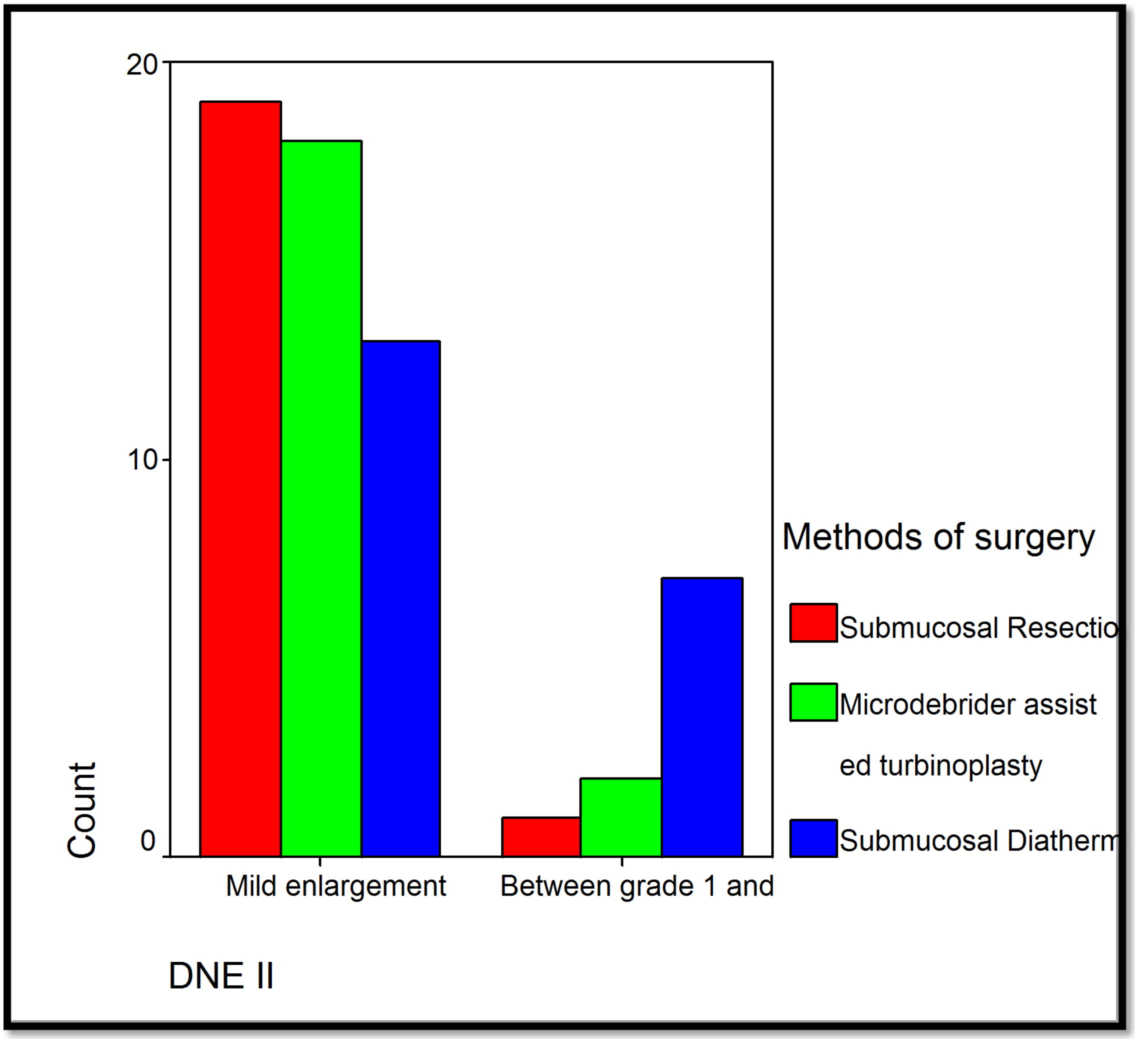
DNE ITH GRADING POSTOP VISIT- II:

Table 18: DNE ITH grading Postop Visit-II (Pearson Chi-square tests)

DNE GRADING OF ITH		METHODS OF SURGERY			P VALUE
		SMRIT	MAIT	SMD	
GRADE I	FREQUENCY	18	19	13	
	PERCENTAGE	90%	95%	65%	
GRADE II	FREQUENCY	2	1	7	
	PERCENTAGE	10%	5%	35%	0.024

DNE ITH GRADING POSTOP VISIT- II:

Chart 15:



SMRIT- 90% in grade 1 and 10% in grade 2

MAIT- 95% in grade 1 and 5% in grade 2

SMD- 65% in grade 1 and 35% in grade 2

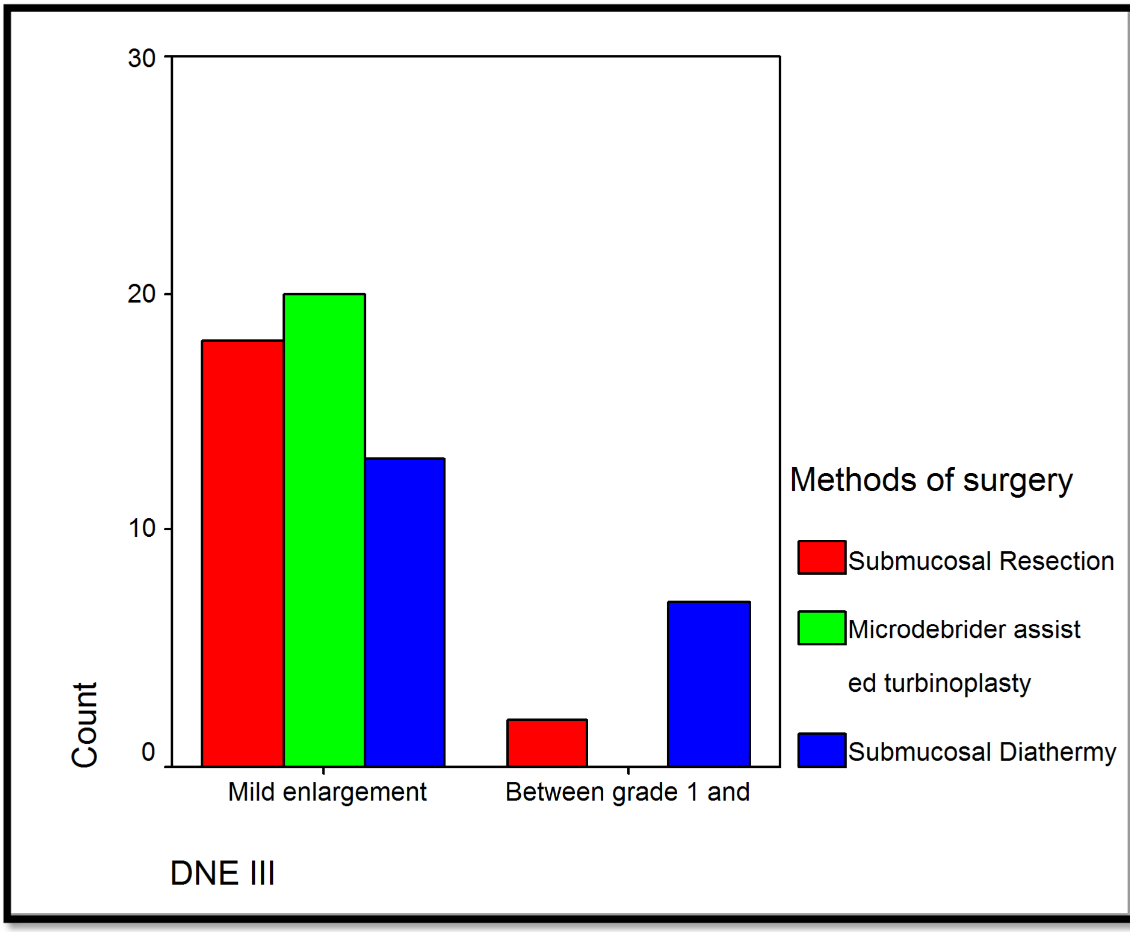
DNE ITH GRADING POSTOP VISIT III:

Table 19: DNE ITH grading postop visit III (Pearson Chi-square tests)

DNE GRADING OF ITH		METHODS OF SURGERY			P VALUE
		SMRIT	MAIT	SMD	
GRADE I	FREQUENCY	18	20	13	0.024
	PERCENTAGE	90%	100%	65%	
GRADE II	FREQUENCY	2	0	7	
	PERCENTAGE	10%	0%	35%	

DNE ITH GRADING POSTOP VISIT III:

Chart 16:



SMRIT- 90% in grade 1 and 10% in grade 2

MAIT- 100% in grade 1

SMD- 65% in grade 1 and 35% in grade 2

POSTOP MUCOCILIARY TRANSIT TIME BY SACCHARIN TEST:

Table 20: Post op Saccharin test and mucociliary clearance time

SACCHARIN TESTS	TECHNIQUE	N	MEAN	STD. DEVIATION	95% CONFIDENCE INTERVAL FOR MEAN		P VALUE
					LOWER BOUND	UPPER BOUND	
POST OP SACCHARIN VISIT I	SMRIT	20	16.95	1.099	16.44	17.46	0.662
	MAIT	20	17.10	1.447	16.42	17.78	
	SMD	20	16.75	1.070	16.25	17.25	
	TOTAL	60	16.93	1.205	16.62	17.24	
POST OP SACCHARIN VISIT II	SMRIT	20	14.00	0.858	13.60	14.40	0.608
	MAIT	20	13.85	0.988	13.39	14.31	
	SMD	20	14.15	0.988	13.69	14.61	
	TOTAL	60	14.00	0.939	13.76	14.24	
POST OP SACCHARIN VISIT III	SMRIT	20	13.90	0.912	13.47	14.33	0.877
	MAIT	20	13.85	0.875	13.44	14.26	
	SMD	20	14.00	1.026	13.52	14.48	
	TOTAL	60	13.92	0.926	13.68	14.16	

Chart 17:

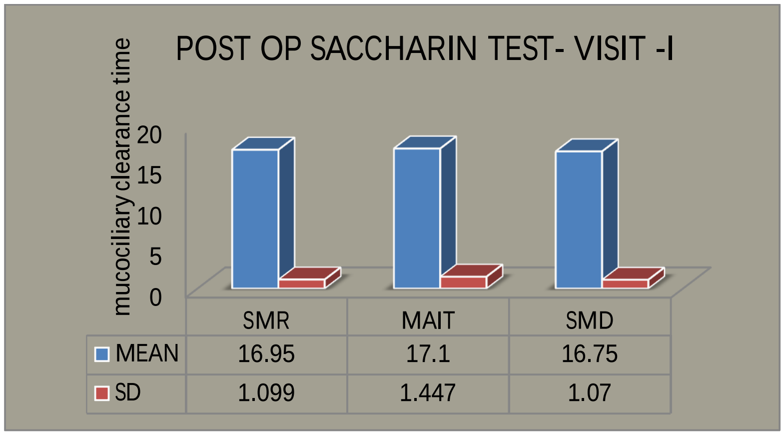


Chart 18:

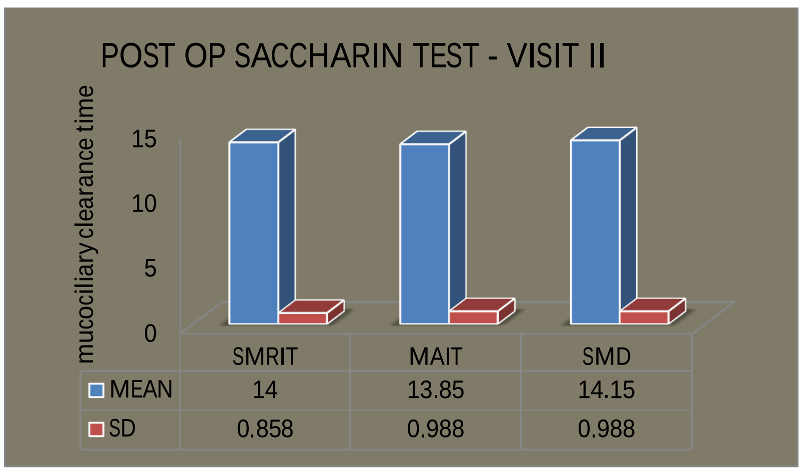
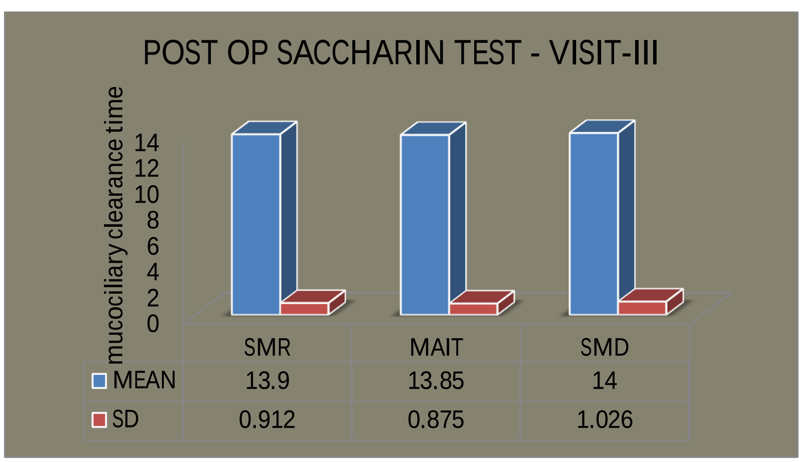


Chart 19:



MEAN MUCOCILIARY CLEARANCE TIME AT POST OP VISIT I

SMRIT-16.95 min

MAIT-17.1 min

SMD-16.75 min

MEAN MUCOCILIARY CLEARANCE TIME AT POST OP VISIT II

SMRIT-14 min

MAIT-13.85 min

SMD-14.15 min

MEAN MUCOCILIARY CLEARANCE TIME AT POST OP VISIT III

SMRIT-13.9 min

MAIT-13.85 min

SMD-14 min

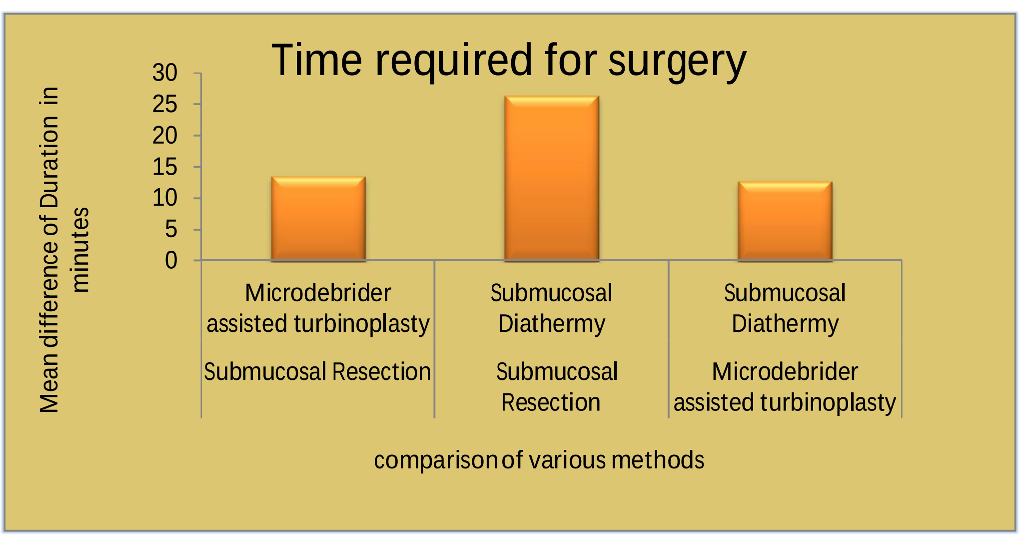
MULTIPLE COMPARISONS BETWEEN THE THREE METHODS OF SURGERY:

DURATION OF SURGERY IN MINUTES:

Table 21: Post Hoc Tests (Tukey HSD)–Multiple Comparisons between methods of surgery-Duration in Minutes

METHODS OF SURGERY (I)	METHODS OF SURGERY (J)	MEAN DIFFERENCE (I-J)	P VALUE
SMRIT	MAIT	13.60	< 0.001
SMRIT	SMD	26.45	
MAIT	SMD	12.85	

Chart 20:



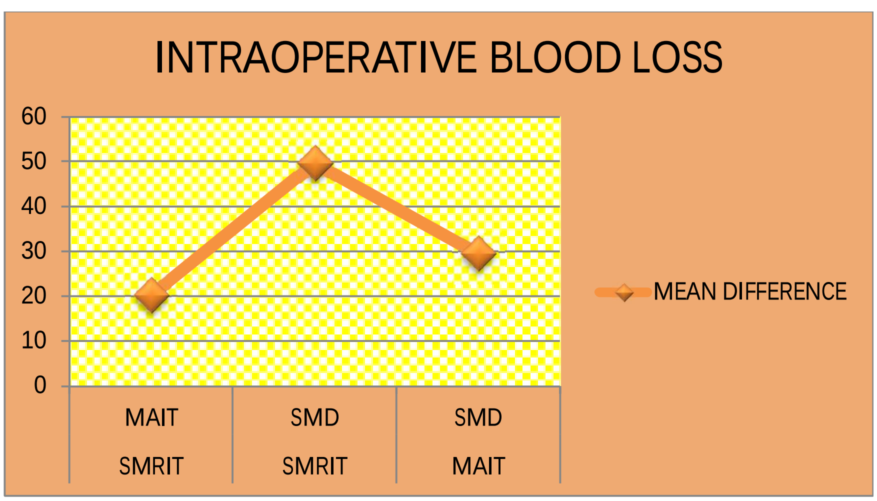
INTRAOPERATIVE BLOOD LOSS:

Table 22: Post Hoc Tests (Tukey HSD)–Multiple Comparisons between methods of surgery-Blood loss in ml

(I) METHODS OF SURGERY	(J) METHODS OF SURGERY	MEAN DIFFERENCE (I-J)	95% CONFIDENCE INTERVAL	
			LOWER BOUND	UPPER BOUND
SMRIT	MAIT	20.20	17.77	22.63
SMRIT	SMD	49.70	47.27	52.13
MAIT	SMD	29.50	27.07	31.93

* The mean difference is significant at the 0.05 level.

Chart 21:

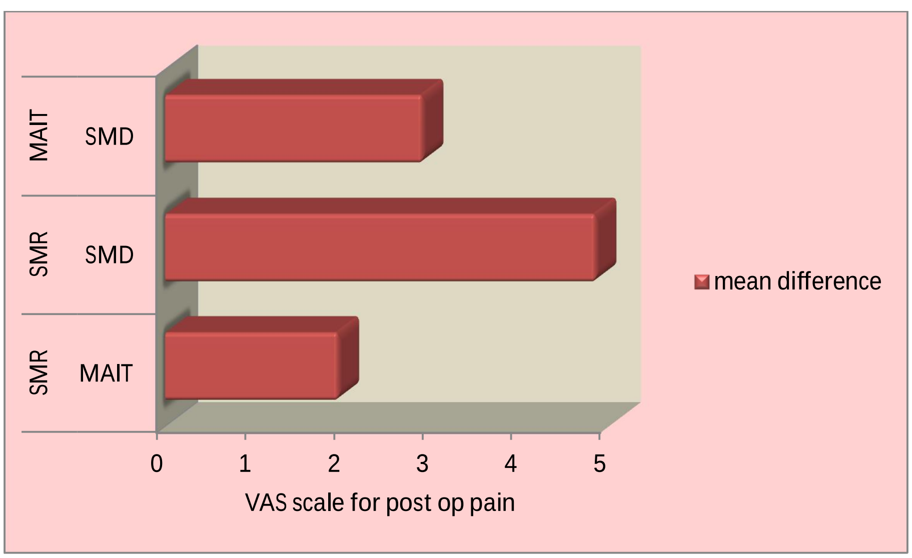


POST-OPERATIVE PAIN:

Table 23: Post Hoc Tests (Tukey HSD) : Dependent variable -Post op pain in VAS scale

(I) METHODS OF SURGERY	(J) METHODS OF SURGERY	MEAN DIFFERENCE (I-J)	95% CONFIDENCE INTERVAL		P VALUE
			LOWER BOUND	UPPER BOUND	
SMRIT	MAIT	1.95	1.28	2.62	< 0.001
SMRIT	SMD	4.85	4.18	5.52	
MAIT	SMD	2.90	2.23	3.57	

Chart 22:



POST OP FOUR POINT SYMPTOM SCALE:

Table 24: Post Hoc Tests (Tukey HSD): Dependent variable – four point symptom scale

DEPENDENT VARIABLE	METHODS OF SURGERY (I)	METHODS OF SURGERY (J)	MEAN DIFFERENCE (I-J)	P VALUE	95% CONFIDENCE INTERVAL	
					LOWER BOUND	UPPER BOUND
POST OP 4 POINT SCALE I	SMRIT	MAIT	0.25	0.702	-.50	1.00
	SMRIT	SMD	-1.05(*)	0.004	-1.80	-.30
	MAIT	SMD	-1.30(*)	<0.001	-2.05	-.55
POST OP 4 POINT SCALE II	SMRIT	MAIT	0.85	0.030	.07	1.63
	SMRIT	SMD	-1.25	<0.001	-2.03	-.47
	MAIT	SMD	2.10	<0.001	1.32	2.88
POST OP 4 POINT SCALE III	SMRIT	MAIT	1.60(*)	<0.001	.72	2.48
	SMRIT	SMD	-1.75(*)	<0.001	-2.63	-.87
	MAIT	SMD	-3.35(*)	<0.001	-4.23	-2.47

* The mean difference is significant at the 0 .05 level.

POST OP MUCOCILIARY TRANSIT TIME:

Table 25: Post Hoc Tests (Tukey HSD): Dependent variable – Post op saccharin test

DEPENDENT VARIABLE	METHODS OF SURGERY (I)	METHODS OF SURGERY (J)	MEAN DIFFERENCE (I-J)	P VALUE	95% CONFIDENCE INTERVAL	
					LOWER BOUND	UPPER BOUND
POST OP SACCHARIN VISIT I	SMRIT	MAIT	-0.15	0.920	-1.08	0.78
	SMRIT	SMD	0.20	0.862	-0.73	1.13
	MAIT	SMD	0.35	0.637	-0.58	1.28
POST OP SACCHARIN VISIT II	SMRIT	MAIT	0.15	0.871	-0.57	0.87
	SMRIT	SMD	-0.15	0.871	-0.87	0.57
	MAIT	SMD	-0.30	0.579	-1.02	0.42
POST OP SACCHARIN VISIT III	SMRIT	MAIT	0.05	0.985	-0.67	0.77
	SMRIT	SMD	-0.10	0.940	-0.82	0.62
	MAIT	SMD	-0.15	0.869	-0.87	0.57

REVIEW OF LITERATURE:

To assure an improvement in nasal airway for the patients without sacrificing the physiological function of the nasal mucosa as well as anticipating minimal adverse effects have been the primary goal of turbinate surgeries over the long run with the fantastic technologies of modern era.

It is stated by Pasaali and his colleagues[42] that submucosal resection delivered the maximum relief of nasal obstruction caused by inferior turbinate hypertrophy when compared with other existing surgical techniques. However, this method leads to damaging of mucosa of the inferior turbinate and entails good surgical skills.

Chen YL and his colleague[43] reported significant increase in crusts ($P < 0.05$) present over the inferior turbinate from 0% to 2.50 ± 0.51 conventional surgical group.

Yañez and Mora[44] agree with this study in significant difference (decrease) of bleeding and crustation after use of microdebrider. Only 4/338 patients has crustation.

Liu CM and his colleague[46] reported no significant difference ($P > 0.05$) between microdebrider and radiofrequency 6 months postoperatively while significant difference was reported between both groups ($P<0.05$) from 1 year up to 3 years.

Back and his colleague[47] in their study reported significant improve in mean saccharin transit time 6 months and 1 year postoperatively.

Chen YL and his colleague[48] reported significant decrease in mean saccharin transit time ($P <0.05$) 1 and 3 months after conventional surgical turbinoplasty and microdebrider turbinoplasty which in line with this study. However, they noticed increase in mean saccharin transit time in surgical group during the first week that may be explained by presence of crusts during this period. This explanation is confirmed by absence of this increase in microdebrider group.

Passali and his colleague[42] issued results of a randomized clinicaltrial containing 382 subjects where they compared six treatment groups, laser cautery, turbinectomy, electrocautery, submucosal resection, cryotherapy, and sub mucosal resection without fracture. After 6 years of follow-up, they documented that submucosal resection provided the better nasal patency and re-establishment of mucociliary clearance.

Chen and his colleague[48] assessed long-term consequences of endoscopic microdebrider without fracture compared with endoscopic submucosal resection alone for inferior turbinate hypertrophy in patients presenting with perennial allergic rhinitis. A total of 145 patients were monitored for 3 years by means of saccharin transit time as outcome measures. Both groups showed similar improvement in saccharin transit time at 1 year continued to 3 years postoperatively.

A study published in "The Layngoscope,119" in the year 2006 comparing microdebrider and radiofrequency assisted inferior turbinoplasty[49] focussed on the subjective assessment of symptoms, mean nasal resistance, mucociliary clearance by saccharin test. There were significant improvement in all outcomes at 6 months, 1 year, 2 years and 3 years post-operatively in MAIT group where p-value is less than .05 for all measures. Significance was noted only after 1 year. There was no significance between two groups 6 months after surgery.

In a study on[50] "Endoscopic partial inferior turbinoplasty" 100 patients were chosen. Simultaneous septoplasty was done in 81 patients, and endoscopic sinus surgery was performed in 43 patients. Synechiae formation was the most commonly encountered complication and was reported in 12 patients; however resolved in almost every case. Nasal obstruction was improved in 93% of the patients. It was concluded that endoscopic partial inferior turbinoplasty is better than turbinectomy procedures and is associated with excellent outcomes and minimal morbidity.

Yet in one another study four of the widely practiced inferior turbinate reduction surgeries[51] for inferior turbinate hypertrophy were evaluated and compared. In all cases turbinectomy was performed as an isolated procedure. Eighty patients with chronic non-allergic rhinitis and hypertrophied inferior turbinates were selected, randomly divided into four groups, and followed up post-operatively for one year. None of the procedures had a deleterious effect on olfactory acuity. In contrast, the operation failed to enhance the mucociliary clearance rate or significantly decrease nasal drainage. Partial inferior turbinectomy and laser turbinectomy improved nasal breathing in 77 per cent of patients, and enhanced olfactory acuity in 78 per cent of patients who had pre-operative hyposmia. The results of turbinoplasty and cryoturbinectomy were less favourable.

A study done by Friedman and colleagues "A safe, alternative technique for inferior turbinate reduction" highlighted the common complications of standard submucous resection of inferior turbinates such as excessive resection, postoperative bleeding, and crusting. The advantage of the microdebrider technique is the precise control of the amount of tissue and location of tissue that is removed on a submucosal plane. The complications encountered with this technique are limited to postoperative bleeding that occurred in 1.6% of patients. There was no crusting or excessive removal of tissue. The results show that submucous resection of inferior turbinates with a microdebrider is a safe method of achieving turbinate size reduction with minimal morbidity[52]

In a study conducted by Mabry[54] it was emphasized that surgery of the inferior turbinates should be performed only after a trial period of medical therapy. Surgical reduction in turbinate size may be accomplished by outfracture crushing, cauterization, cryotherapy, laser vaporization, submucous resection, partial turbinate resection, turbinoplasty, or total turbinectomy. The procedure chosen should be the most conservative one consistent with obtaining a good airway.

The paper on “Surgical treatment of the inferior turbinate: new techniques” by Chang and colleagues highlights recently published literature regarding current popular and cutting-edge techniques[55]. There is a trend toward less invasive techniques that can potentially be performed in the clinic setting, rather than in the operating room. In addition, surgical turbinate intervention demonstrates benefit in controlling symptoms of allergic rhinitis other than nasal obstruction.

A study done by Cavaliere[56] and colleagues compared conventional turbinate reduction with radiofrequency assisted turbinoplasty. In group A, the turbinoplasty (TP) was performed using the classical surgical submucosal resection; in group B, the RFVTR was applied to inferior turbinate; and group C patients were not treated and served as control subjects. Nasal endoscopy, visual analogue scale (VAS), anterior active positional rhinomanometry, and saccharin tests were used to assess treatment outcomes at the end of week 1 and months 1 and 3 after surgery. Turbinate edema and secretions decreased significantly (P <

Results of the study conducted by Huang and colleagues suggest that endoscopic microdebrider-assisted inferior turbinoplasty[57] is effective for decreasing nasal resistance and improving quality of life in patients with perennial allergic rhinitis who have substantial nasal congestion. Turbinate surgery is an effective treatment for chronic nasal obstruction induced by perennial allergic rhinitis. Many techniques of turbinate reduction have been performed, including partial or total turbinate resection, cauterization, cryotherapy, laser therapy, and radiofrequency ablation. Disadvantages of these traditional techniques include bleeding, crusting, synechia formation, osteitis, inadequate volume reduction, and atrophic rhinitis. Furthermore, the multiplicity of techniques indicates the lack of consensus on the "gold standard" for inferior turbinate reduction.Because the respiratory mucosa is essential to proper physiologic functioning of the turbinates, such as warming and humidification of inspired air and mucociliary clearance, the ideal turbinate surgery would effectively reduce the volume of the submucosal stromal tissue while preserving the overlying respiratory epithelium and averting complications. It has been reported that submucosal turbinectomy is an excellent procedure for reducing not only nasal congestion but also sneezing and rhinorrhea in patients with perennial allergic rhinitis. However, microdebrider-assisted powered reduction of the inferior turbinate has not proved effective in these patients, although it provides a method for achieving volume reduction with mucosal preservation and minimal risk for complications. The microdebrider, which has been widely used in nasal surgery for the past decade, is supposed to provide real-time suction with the ability of precise tissue resection. Although several studies proposed the feasibility of using the microdebrider in inferior turbinate surgery, the postoperative changes in nasal resistance and quality of life remained unexplored. With the advent of a newly designed small (2.0-mm) microdebrider blade incorporated with an elevator, endoscopic submucosal turbinate reduction was performed with this instrument in the clinical setting with the patient under local anaesthesia. The purpose of this study was to evaluate the objective and subjective outcomes in patients with perennial allergic rhinitis who had substantial mucosal hypertrophy of the inferior turbinates and who underwent endoscopic microdebrider-assisted inferior turbinoplasty.

A paper published by Wolfswinkel, Erik M., et al on "A modified technique for inferior turbinate reduction: the integration of coblation technology" proves that this modified hybrid technique[58] is the mainstay of the senior author's treatment of inferior turbinate hypertrophy reduction and can be a useful surgical tool to achieve adequate outcomes when dealing with patients who have hypertrophied inferior turbinates that fail medical management..

A study[59] published in "International Journal of paediatric otorhinolaryngology" compared submucosal resection and microdebrier assisted turbinoplasty. In the SR group, turbinate edema was decreased significantly at 1 and 3 months after surgery ($p < 0.05$) in the SR group at 1 week after surgery. In the MAIT group, turbinate edema and nasal secretions were decreased significantly at 1 and 3 months after surgery ($p < 0.05$). Nasal crusting was not observed after surgery. Subjective complaints including nasal obstructions, sneezing, rhinorrhea and hyposmia were significantly improved in both groups from 1 month after surgery ($p < 0.05$). Saccharin transit time was significantly increased ($p < 0.05$) compared to baseline at 1 week after surgery in the SR group but was not significantly different in the MAIT group.

A study on "Comparison of microdebrider-assisted inferior tubinoplasty and submucosal resection for children with hypertrophic inferior turbinates"[60] was conducted by Lee and colleagues. In the SR group, turbinate edema was decreased significantly at 1 and 3 months after surgery ($p < 0.05$). Nasal secretions and crusting were increased significantly ($p < 0.05$) in the SR group at 1 week after surgery and then decreased significantly at 1 and 3 months after surgery. In the MAIT group, turbinate edema and nasal secretions were decreased significantly at 1 and 3 months after surgery ($p < 0.05$). Saccharin time was significantly increased ($p < 0.05$) compared to baseline at 1 week after surgery in the SR group but was not significantly different in the MAIT group.

The study by Chen and colleagues in 2007 proved that Powered turbinoplasty [61] was superior to submucosal cauterization on all aspects of the assessment. A significant difference ($p < 0.05$) was noted for postoperative crusting, endoscopical scoring of turbinate size and acoustic rhinometry measurements of nasal cavity volume and mean area at the level of nasal valve. In addition, the results of powered turbinoplasty were still apparent on long term follow-up, whereas submucosal cauterization was associated with a recurrence of turbinate hypertrophy.

As early as 1987, a study on turbinate surgery and its efficacy was designed. The results of turbinate reduction surgery[62] carried out on 307 patients are reviewed. This is a retrospective study over 16 years. The results of submucosal diathermy with and without outfracture, partial inferior turbinectomy and linear cautery were all equally disappointing in the long term. At 1 month postoperatively the overall success rate, as defined by patient satisfaction was 82%, but this declined steadily with time to 60% at 3 months,

54% at 1 year and 41% at 1-16 years. There was no significant difference found in the success rates between methods of turbinate reduction used.

In a quite recent study by Yanez, Carlos, and Nallely Mora[44] on "Inferior turbinate debriding technique: Ten year results" in the year 2008 followed the patients over a long term to provide concise results. Symptom-free patients were observed in 91.3%, partial symptoms in 5.2%; 3.5% of the patients had recurrence of nasal obstruction 10 years postoperatively. Endoscopy, anterior rhinometry, and mucociliary transit time revealed long-term improvements. Few complications were observed.

Another study on “Long term effects of submucosal turbinectomy in patients with perennial Allergic Rhinitis” was published on ‘The Laryngoscope’ by Mori and colleagues .[63] The mean [± SD] total nasal symptom score (maximum 9) was significantly lower at 1 year surgery (7.5 ± 1.6 vs 1.8 ± 1.8, $p < .0001$) compared with before surgery. A significant improvement in nasal symptoms was noted after 3-year (2.8 ± 2.3, $p<.0001$) and 5-year (3.3 ± 1.6, $p<.0001$) time points. A significant increase in total nasal airflow value was noted as each time point after surgery, with a gradual reduction in the total nasal symptom score as well (before surgery, 269.4 ± 249.5 cm^3/s; 1 year after

surgery, 450.1 ± 197.7 cm^3/s; more than 3 years after surgery, 385.1 ± 182.3 cm^3/s). The nasal challenge test score was also reduced 1 year after surgery (2.1 ± 1.0 vs 0.6 ± 0.7, $p<.0001$) after surgery. In regard to postoperative quality of life, according to the results of the card questionnaire, 50% of the patients had not been receiving antiallergic treatments in the postoperative period. The results concluded that submucous tubinectomy is a useful strategy for the long-term management of nasal allergic reaction and contributes to the improvement in quality of life.

DISCUSSION:

Surgical intervention of the inferior turbinates has been tried for a very long time going upto 100 years back in history to improve the nasal airway. Widely ranging from old aged radical total turbinectomy to the era of modernised turbinoplasty using microdebrider , various methods have been practised for this purpose. Putting together, Hol et al. after reviewing all these procedures, concluded that though many methods reduce the size of the turbinates, they also cause damage to the mucosal lining of the turbinates thereby altering the functions and leading to a secondary cause of nasal obstruction. They arrived at a conclusion which specified "infra-turbinal turbinoplasty"[64] as the preferred approach. The terminology of "mucosa preserving turbinoplasty" came into existence with the advent of New technologies such as radiofrequency, coblation and microdebrider.A relatively novel and recent procedure is microdebrider-assisted inferior turbinoplasty.Eventhough the procedure is labelled as turbinoplasty,some also do resection of the mucosal tissue making it appear as partial turbinectomy [65]. Nasal obstruction having sufficient improvement, mucosal injury and bleeding are the big concerns of this method.

INTERPRETATION AND ANALYSIS OF THE RESULTS & LITERATURE:

1.ANALYSIS OF DEMOGRAPHIC DATA:

AGE DISTRIBUTION:

60% of the patients in the study are between 21 and 30 yrs of age and 28% are between 31 and 40 yrs. The adolescent and old age group pateints are less in number in the present study.

GENDER RATIO:

The number of male and female patients enrolled in this study from a population of 150 patients with inferior turbinate hypertrophy who attended the ENT OPD of our institution during the study period and satisfied the inclusion criteria for this study, 60 were selected by Consecutive (Non – Random) Sampling. The male population in the study was more accounting for 65% of the study groups than the female patients. The gender of the patient did not affect the outcome of the technique in any significant way.

2.ANALYSIS OF THE FACTORS AFFECTING THE OUTCOME OF THE PROCEDURE :

INFERIOR TURBINATE GRADING :

The ideal way for candidate selection for our study being those patients with consistent nasal symptoms especially nasal obstruction with additional allergic symptoms in spite of completely attempted medical treatment, most of the patients selected for the study fell into grade 3 of inferior turbinate hypertrophy.

The exact number went up to 40 with grade 3 ITH grading accounting for two thirds of the study population, leaving the remaining 20 in grade 2 ITH category. The data of percentage of study population chosen for each individual surgery among the different grades of ITH are subjected to analysis using Pearson Chi-square tests. among the 20 patients who had grade 2 ITH , 45% fell into the category of SMRIT, 25% were taken up for MAIT and 30% underwent SMD.

MUCO CILIARY ASSESMENT WITH SACCHARIN TEST:

The inferior turbinate as well known for its wide surface area has the greatest impact on mucociliary clearance of the nasal and sinus secretions emphasising its importance in one of the m ajor functions of the nose. With appropriate evidence, assessment of mucociliary clearance time is best done with saccharin test.

MEAN MUCOCILIARY CLEARANCE TIME AT POST OP VISIT I

SMRIT-16.95 min

MAIT-17.1 min

SMD-16.75 min

MEAN MUCOCILIARY CLEARANCE TIME AT POST OP VISIT I

SMRIT-14 min

MAIT-13.85 min

SMD-14.15 min

MEAN MUCOCILIARY CLEARANCE TIME AT POST OP VISIT I

SMRIT-13.9 min

MAIT-13.85 min

SMD-14 min

We didn’t find any statistical difference in the mucociliary clearance time done postoperatively for all the three study groups. But we could see decrease in mucociliary clearance time postoperatively.

3.ANALYSIS OF THE INTRAOPERATIVE PARAMETERS :

DURATION OF SURGERY:

In this study, the calculated mean time required for surgery was around 36 min which consumes the longest time mentioned. The surgery using submucosal diathermy takes a mean time of 10.15 min for the whole procedure to be completed in the shortest time noticed. Whereas the procedure carried out using microdebrider for inferior turbinoplasty gets over in an average time of 23 min. Well, it is now very obvious to make a note of the shortest time taken for the surgery is SMD followed by MAIT and SMRIT in the increasing order of time. As we appreciate, SMD has been considered the procedure to be completed in no time. Comparing between the microdebider turbinoplasty and conventional SMRIT, we conclude microdebrider does save us some time. The shorter operating time of SMD is the ease of the procedure. Microdebrider takes an upper hand over conventional method due to the efficient suction of tissues and blood by microdebrider concurrently,which offers an improved bloodless field and better visibility, when compared to conventional instruments which needed longer time to control bleeding.

OPERATIVE FIELD VISIBILITY:

The BOEZAART VANDERMERWE grading was applied for assessment of the operative field visibility of the various procedures in our study. Most of those patients in study group of SMRIT category required frequent suctioning to obtain a better vision of operating field accounting for 50% of the respective group. There were also a portion of the SMRIT group for whom there was difficulty in proper visualisation of the field during the operation adding up to 30%. The visibility of operative field was quite better in micro-debrider assisted turbinoplasty when compared to the conventional SMRIT method with 80% of patients having grade 2 visibitlity. Nevertheless, we have the best outcome measure as far as peroperative field of visilbility is concerned from the study group of SMD patients. The diathermy shining up with its fantastic abilities to provide us with the best operating field takes the credit of having all the cases under grade 2 of better visibility with infrequent suctioning, where many a time we needn't use suction at all.

BLOOD LOSS:

The average blood loss during surgery recorded in SMRIT patients was 50.80 ml. The study group of MAIT patients had a mean blood loss of 30.60 ml. Whereas the patients in SMD group seemed to be almost devoid of blood in the field hardly accounting for a mean blood loss of only 1.10 ml. Even that little ml of blood loss could be only from the initial prick using cautery needle, leaving the surgeons with the boon of bloodless surgery and thereby requiring very less time. When it comes to microdebrider vs conventional SMRIT, MAIT upgrades with the better benefit of lesser blood loss than SMRIT. This can be attributed to the uniqueness of microdebrider with its suction port as well as specially designed blades which could aid in the inferior turbinoplasty.

4.ANALYSIS OF POST-OPERATIVE SEQUELAE OF THE PROCEDURES:

POST OPERATIVE PAIN VAS:

Giving a score ranging from 1 to 10 in visual analogue scale , the postoperative pain in each study group is measured. 0.6 was the number for SMD group of patients implying the least pain encountered. MAIT patients had a mean VAS score of 3.5 whereas SMRIT group of patients suffered the most pain of all the three categories with an average score of 5.45

POST OP CRUSTING:

80% of IT patients followed up with grade 1 crusting. 75% of MAIT had grade 1 crusting. 75% of SMD patients had no crusting.

POST OP SYNECHIAE:

Synechiae occurs when there is mucosal contact during the healing process. Minimal tissue trauma and avoiding mucosal damage are important to minimize scarring and this is offered by microdebrider. 15% of SMRIT pts had post-operative synechiae. 5% of MAIT pts were witnessed with synechiae. Whereas SMD group had no postoperative synechiae as there was no chance of mucosal contact.

5.ANALYSIS OF OUTCOMES OF THE SURGERY:

FOUR POINT SCALE FOR SUBJECTIVE ASSESSMENT:

The symptom scale assessment has been the more satisfactory in interpreting the subjective improvement all of which depends on the patients' history. This kind of quantification, presentation and interpretation of the results would help to appreciate better the efficacy and capacity of the procedure in attaining one of the objectives stated at the outset of the study, and also helps to analyse and understand the most appropriate technique we can choose for the procedure. The four point scale is noted down with the patients' progress in symptoms in all the three visits. The mean values of four point symptom scale in SMRIT study group in post op visits 1,2 and 3 are 5.85, 3.40 and 2.65 respectively. That of MAIT group are 5.60, 2.55 and 1.05. The values for SMD are 6.90, 4.65 and 4.40. The reports show significant improvement of symptoms in all the study groups with the best results in MAIT study group.

POST OP ASSESSMENT OF ITH:

Postop visit 1:

SMRIT- 60% fall into grade 1 and 40% in grade 11

MAIT- 65% in grade 1 and 35 % in grade II

SMD- 20% in grade I and 80% in grade II

Postop visit 2:

SMRIT- 90% in grade 1 and 10% in grade 2

MAIT- 95% in grade 1 and 5% in grade 2

SMD- 65% in grade 1 and 35% in grade 2

Postop visit 3:

SMRIT- 90% in grade 1 and 10% in grade 2

MAIT- 100% in grade 1

SMD- 65% in grade 1 and 35% in grade 2

The above mentioned results clearly states that there has been very significant improvement in the airway reflected by the downgrading of inferior turbinate hypertrophy. MAIT study group of patients experience an excellent objective improvement in the relief of nasal obstruction which is denoted by the results of 95% of the study patients with grade 1 ITH at the 2nd postoperative visit and 100% improvement with grade 1 ITH at the end of the 3rd post-operative visit 3 months after surgery.

Nevertheless, patients included in the study group of SMRIT also revealed noticeable results with 90% of patients showing grade 1 ITH which in turn implies a reasonable relief of nasal obstruction.

To throw lights on SMD patients from the data above, there was good positive feedback only in 65% of patients with objective improvement. The rest had improvement in symptoms as well the ITH for a short while only to revert back to the initial stage of presentation.

POST OP SACCHARIN FOR MUCOCILIARY TRANSIT TIME:

MEAN MUCOCILIARY CLEARANCE TIME AT POST OP VISIT I

SMRIT-16.95 min

MAIT-17.1 min

SMD-16.75 min

MEAN MUCOCILIARY CLEARANCE TIME AT POST OP VISIT II

SMRIT-14 min

MAIT-13.85 min

SMD-14.15 min

MEAN MUCOCILIARY CLEARANCE TIME AT POST OP VISIT III

SMRIT-13.9 min

MAIT-13.85 min

SMD-14 min

When revising the charts and tables of mucociliary clearance from above results, it could be found that there was no statistical difference in comparing the three techniques. Perhaps, the mucociliary clearance time has considerably improved over the preoperative values proposing us the importance of inferior turbinate mucosa in mucociliary clearance.

RECURRENCE:

Two patients who were included in the study group of SMD ended up with recurrence. There was no recurrence noticed in the other two study groups till the period of follow up.

CONCLUSION:

Although each technique has its own importance in inferior turbinate reduction surgeries, microdebrider indeed showed maximum benefits due to its unique properties. It is the technique of highest efficacy and least complication. SMD is the easiest technique done under local anaesthesia. SMRIT needs much more fine skilful hands. There was statistically considerable difference between microdebrider assisted inferior turbinoplasty and the conventional submucosal resection in subjective and objective assessment scales at postoperatively. SMD consumed very less time in performing the surgery and MAIT also could be completed in no longer time. When we look into complications like crusting and synechiae, they seemed to occur more in the SMRIT group. This might be attributed to the elevation of mucosal flaps and creating a raw surface in the same group of patients. Microdebrider has less crusting compared to the conventional method. The surgical field visibility was significantly better in the groups where microdebrider and diathermy were used compared to conventional method. In postoperative course there was no significant statistical difference between the three methods with respect to the mucociliary clearance time. Recurrence was noted in two cases both of them happened to be in the SMD study group. The powered instrument microdebrider and the specialized blade for inferior turbinate have come along with amazing qualities and more user friendly for the surgeon.

ANNEXURES

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PROFORMA

NAME : AGE / SEX: OP/ IP.NO:
DOA:
DOS:
DOD:

I. CHIEF COMPLAINTS

1. C/O nasal obstruction
2. C/O recurrent sneezing

II. HISTORY OF PRESNT ILLNESS

1. H/O Nasal Obstruction

Duration	Onset	Side	Spontaneous	Periodicity	Agg fac	Rel fac

2. H/O Nasal Discharge:

Duration	Type	Odour

3. H/O sneezing – duration, periodicity
4. H/o smell disturbances
5. H/o headache
6. H/O trauma
7. H/O pain in the nose
8. H/O epistaxis
9. H/o postnasal drip

Ear complaints:

a. H/o Ear discharge
b. H/o Ear pain

Throat Complaints:

a. H/o Throat pain:
b. H/o. Dysphagia / Odynonophagia:
c. H/o Snoring:
d. H/o Mouth Breathing:

III. Past History:

1. Medical

a. H/o Allergy / Asthma / exposure to allergens
b. H/o any medical illness:
2. Surgical
a. H/o Previous surgery in ear / Nose/ Throat:
b. H/o Any other previous surgery:
3. H/o Trauma:

IV. Family H/o

V. General Examination

a. General Condition:
b.

Anemia	Jaundice	Cyanosis	Clubbing	Pedal edema	GLINE

c. Vitals:

VI. Systemic examination:

a. CVS:
b. RS:
c. P/A:
d. CNS:

VII. Local examination:

1. Examination of Nose:
    a. External framework:
    b. Anterior Rhinoscopy:

	Right nostril	Left nostril
Septum		
Turbinates		
Meati		
Mucosa		

    c. Posterior Rhinoscopy
    d. Para Nasal Sinus examination
    e. Cold Spatula Test
    f. Cotton wisp test

2. Examination of Ears:
3. Examination of Throat

VIII. Investigations:

1. CBC, RFT, Grouping and typing,Urine routine
2. CXR, ECG
3. **DNE:**

ITH grading-

4. **CT – PNS:**

SURGERY:

Technique:

Visibility/Accessibility:

Blood loss:

Duration:

FOLLOW UP:

<table>
<tr><td rowspan="3"></td><td colspan="5">SUBJECTIVE ASSESSMENT</td><td colspan="2" rowspan="2">OBJECTIVE ASSESSMENT</td></tr>
<tr><td colspan="4">FOUR POINT SCALE</td><td>VAS</td></tr>
<tr><td>NASAL OBSTRUCTION</td><td>NASAL DISCHARGE</td><td>HEADACHE</td><td>HYPOSMIA</td><td>PAIN</td><td>DNE</td><td>SACCHARIN TEST</td></tr>
<tr><td>PRE OP</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>POST-OP VISIT 1 (1 WEEK)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>POST-OP VISIT 2 (4 WEEKS)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>POST-OP VISIT 3 (12 WEEKS)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Post op:

Crusting-

Synechiae-

Recurrence-

CONSENT FORM

Study Title: COMPARATIVE STUDY OF MICRODEBRIDER ASSISTED TURBINOPLASTY, SUBMUCOSAL DIATHERMY AND CONVENTIONAL SUBMUCOSAL RESECTION IN THE MANAGEMENT OF HYPERTROPHIED INFERIOR TURBINATE

I _______________ hereby give consent to participate in the study conducted by DR. J.ANGEL post graduate in KILPAUK MEDICAL COLLEGE and GOVT ROYAPETTAH HOSPITAL, Chennai-10, and to use my personal clinical data and result of Investigation for the purpose of analysis and to study the nature of disease. I also give consent for further investigations.

Signature/Thumb impression *Place* *Date*
of the patient/relative

Patient name and Address

Signature of the Investigator

Signature of the Guide

MASTER CHART

Name	Age	Sex	IP no	preop 4 po	pre op DNI	preop sacc	Method	duration	visibility	blood loss	postop pai	crusting	synechiae	postop 4 p	postop 4 p	postop fou	DNE I	DNE II	DNE III	postop sac	postop sac	postop saccharin III
Prem kuma	18	M	13108	8	2	19	S	40	3	47	6	1	A	4	1	1	1	1	1	17	14	14
Hari	21	M	13866	11	3	20	S	35	3	48	5	2	P	5	3	3	2	1	1	16	14	14
Vatchala	28	F	10276	10	3	17	S	35	2	54	4	2	A	6	3	3	2	1	1	17	14	14
Selvi	48	F	13467	9	3	18	S	43	3	55	6	1	A	5	4	2	1	1	1	17	15	15
Vasanth	42	M	7087	9	2	17	S	40	2	50	5	1	P	6	3	2	1	1	1	15	13	13
Bahadhur	25	M	14141	11	3	18	S	40	3	52	6	1	A	7	4	3	2	1	1	17	13	12
Syed Jaffer	25	M	13879	9	2	18	S	43	2	45	5	1	A	6	4	3	1	1	1	16	14	14
Kalamullah	31	M	11634	11	3	20	S	35	2	46	5	1	A	7	4	2	2	1	1	18	15	13
Hemalatha	23	F	15794	9	2	18	S	30	3	40	6	2	A	5	3	3	1	1	1	16	14	14
Rajesh	23	M	16958	8	2	16	S	30	4	55	7	1	A	6	4	3	1	1	1	16	13	13
Jayashri	19	F	15952	11	3	19	S	35	4	60	5	2	A	7	4	3	2	2	1	17	14	15
Palani	40	M	17354	9	2	18	S	40	3	57	6	1	A	7	4	3	1	1	2	18	15	15
Vijayakuma	28	M	17604	11	3	19	S	35	3	53	5	1	A	8	3	3	2	1	2	17	15	15
Prakash	23	M	19113	9	2	18	S	38	3	52	7	1	A	5	3	3	1	1	1	16	13	13
Rani	35	F	15710	11	3	20	S	35	4	55	5	1	P	6	3	3	1	1	1	18	14	14
Dheenadha	34	M	16921	9	2	18	S	38	4	50	4	1	A	5	3	3	1	1	1	17	15	15
Karthick	25	M	15352	9	3	17	S	35	4	52	6	1	A	5	3	2	1	1	1	17	14	13
Chitra	32	F	19372	7	2	22	S	30	3	50	3	1	A	5	4	3	1	1	1	20	15	15
Raghu	30	M	19929	11	3	18	S	35	4	47	6	2	A	6	4	2	2	1	1	16	12	13
Amalan	19	M	19299	11	3	22	S	40	3	48	7	1	A	6	4	3	2	1	1	18	14	14
Antony	25	M	20004	10	3	20	M	20	3	28	2	1	A	6	1	0	2	1	1	20	15	15
Arumugam	40	M	20169	8	2	16	M	20	2	35	3	1	A	4	2	1	1	1	1	16	14	14
Rukmandir	19	M	19509	9	3	18	M	25	2	32	4	1	A	6	2	0	2	2	1	16	15	15
Mohd Rafi	24	M	20718	11	3	22	M	28	2	32	4	1	A	5	2	1	2	2	1	18	14	14
Abbas	31	M	789	9	3	19	M	25	3	33	3	1	A	5	2	1	1	1	1	17	14	14
Anadajothi	30	F	307	13	3	22	M	23	2	30	2	1	A	7	3	2	1	1	1	18	13	14
Renuka	35	F	1803	11	3	20	M	24	2	35	4	2	A	6	3	1	1	1	1	15	14	14
Murugan	28	M	1193	11	3	18	M	22	2	32	5	1	A	6	4	2	2	1	1	17	13	13
Gopinath	24	M	2521	10	3	20	M	25	2	30	3	1	P	5	3	1	1	1	1	18	14	14
Surya	20	M	1937	13	3	23	M	26	2	29	4	1	A	8	4	2	2	1	1	20	16	15
Naveen	25	M	1889	9	3	20	M	20	2	27	3	2	A	6	4	0	1	1	1	18	13	14
Annapoora	47	F	4321	12	3	18	M	25	2	28	4	1	A	8	2	1	1	1	1	17	15	15
Yogaraj	20	M	3860	9	2	17	M	25	3	30	5	2	A	4	2	1	1	1	1	15	12	12
Mahalaksh	36	F	7433	10	2	18	M	20	2	33	2	1	A	5	1	1	1	1	1	17	13	13
Jeeva	22	M	7893	11	3	18	M	24	2	32	4	1	A	5	2	1	1	1	1	16	14	13
Vijayalaksh	22	F	7162	10	2	20	M	18	2	25	3	1	A	5	2	0	1	1	1	18	13	13
Karthikeya	24	M	6464	11	3	21	M	20	2	28	3	2	A	6	3	2	2	1	1	18	14	14
Sivakumar	24	M	8142	11	3	18	M	25	2	28	4	1	A	6	3	1	1	1	1	17	13	13
Edwin raj	22	M	8710	8	2	16	M	25	2	35	3	1	A	4	3	1	1	1	1	15	13	13
Suguna	21	F	7992	10	3	17	M	20	3	30	5	1	A	5	3	2	2	1	1	16	15	15
Paramanar	29	M	7005	11	3	20	D	10	2	2	1	0	A	6	2	2	2	1	1	18	15	14
Jarina	35	F	8563	7	2	18	D	7	2	1	1	0	A	5	1	1	1	1	1	17	15	15
Rengan	32	M	5285	10	3	18	D	10	2	0	0	0	A	7	4	3	2	1	1	16	13	13
Kannan	30	M	5888	9	2	16	D	8	2	1	0	1	A	7	5	7	2	2	2	15	14	14
Selvi	29	F	3504	10	3	20	D	12	2	1	1	0	A	7	5	4	2	1	1	18	15	15
Palani	31	M	2561	9	3	16	D	10	2	2	1	1	A	6	5	4	2	1	2	16	13	13
Vijayan	30	M	3481	10	3	17	D	9	2	1	1	0	A	7	5	4	2	2	2	16	14	12
Kuppu	34	F	2655	9	2	18	D	12	2	1	0	0	A	7	5	5	1	1	1	17	13	13
Vandana	24	F	5247	10	3	18	D	9	2	3	2	0	A	7	5	5	2	1	2	17	16	14
Balu	32	M	7410	10	3	16	D	12	2	2	1	0	A	7	6	6	2	1	2	15	14	14
Manimega	30	F	6540	7	2	20	D	11	2	1	0	1	A	6	3	2	1	1	1	18	16	16
Lakshmi	25	F	3520	10	3	19	D	10	2	0	0	1	A	7	5	5	2	2	2	17	14	14
Dinesh	23	M	3981	10	3	18	D	14	2	1	0	0	A	6	6	5	2	2	1	16	14	15
Indu	23	F	2601	9	3	18	D	8	2	0	1	0	A	7	6	9	2	1	2	17	12	12
Panjali	32	F	5246	10	3	20	D	10	2	1	1	0	A	8	6	5	2	2	1	18	14	14
Sajid	40	M	5369	10	3	17	D	7	2	2	0	1	A	8	5	5	2	2	1	16	14	14
Sundar	32	M	4528	11	3	20	D	10	2	0	1	0	A	8	4	4	2	1	1	18	15	15
Rajasekar	29	M	5714	11	2	19	D	10	2	1	0	0	A	7	5	3	1	1	1	17	14	14
Babu	35	M	5468	10	2	20	D	12	2	1	0	0	A	7	4	4	2	1	1	18	14	14
Arulmozhi	28	F	2561	10	3	15	D	12	2	1	1	0	A	8	6	5	2	2	1	15	14	15

INSTITUTIONAL ETHICAL COMMITTEE
GOVT. KILPAUK MEDICAL COLLEGE
CHENNAI-10
REF.NO.18520/ME-I/Ethics/2013 Dt:05.12.2013
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai-10 reviewed and discussed the application for approval "A Comparative Study of microdebrider assisted turbinoplasty, submucosal diathermy and conventional submucosal resection in the management of hypertrophied inferior turbinate" – For Project work submitted by Dr.J.Angel, MS (ENT) PG Student, KMC, Chennai-10.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occuring in the course of the study any change in the protocol and patient information / informed consent and asks to be provided a copy of the final report.

GOVT. KILPAUK MEDICAL COLLEGE ★ Kilpauk, Chennai-10. ★
2 8 JAN 2014

28/1/14.
CHAIRMAN
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Govt. Kilpauk Medical College, Chennai

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A Dissertation on

"COMPARATIVE STUDY OF MICRODEBRIDER ASSISTED TURBINOPLASTY, SUBMUCOSAL DIATHERMY AND CONVENTIONAL SUBMUCOSAL RESECTION IN THE MANAGEMENT OF HYPERTROPHIED INFERIOR TURBINATE"

12 Submitted to the

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

In partial fulfilment of the requirements

For the award of the degree of

M.S.BRANCH IV
(OTORHINOLARYNGOLOGY)

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